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BULLETIN 275 FEBRUARY, 1926

Connecticut Agricultural Experiment Station

New Haven, Connecticut

TWENTY-FIFTH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

1925

W. E. BRITTON, Ph.D.
State Entomologist

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The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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as of

February, 1926

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CONTENTS

	PAGE
Twenty-Fifth Report of the State Entomologist of Connecticut	215
Letter of Submittal	215
Report of Receipts and Expenditures	215
Summary of Inspection and Office Work	216
Publications of the Entomological Department, 1925	217
Department Staff and Work	217
Entomological Features of 1925	219
Fruit Insects	219
Vegetable Insects	223
Insects Attacking Field Crops	227
Shade and Forest Tree Insects	227
Household Insects	229
Miscellaneous Insects	230
Convention of Entomological Workers	231
Inspection of Nurseries in 1925	232
The New Law Providing for the Registration and Inspection of Nurseries	232
Nursery Certificates	233
Dealer's Permits	234
Shipper's Permits	235
Package Certificates	235
Quarantines	236
Inspection Work	236
List of Pests Found in Nurseries in 1925	237
Number of Nurseries	238
Nursery Firms in Connecticut Receiving Certificates in 1925	238
Inspection of Raspberry Plantations	242
Nursery Dealers	243
Out-of-State Shippers	243
Inspection of Imported Nursery Stock	244
Pests Found on Imported Nursery Stock	246
Inspection of Apiaries in 1925	246
European Foul Brood	247
American Foul Brood	248
Sacbrood	249
Paralysis	249
Statistics of Inspection	250
Summary	253
Report of Gipsy Moth Work	253
New Equipment	254
Details of the Work by Towns	254
Statistics of Infestations	267
Summary of Statistics	269
Quarantine	270
Parasites	270
Financial Statement	272
Further Experiments in Dusting and Spraying Apple Orchards	272
Orchard Under Experiment	273
Acknowledgments	273
Method of Recording Data	273
Materials and Apparatus Used	274
Arrangement of Plots in the Platt Orchard	274
Summary and Conclusions	277

PAGE

Efficiency of Delayed Dormant Applications for the Control of Apple Aphids 278
Summary 280
The Oriental Peach Moth in 1925 280
The Curculio Problem in Connecticut 286
Tests of Alcohol-Formalin for Control of American Foul Brood in Bees 291
The Pear Psylla in Connecticut 292
The Different Stages 293
Biology and Control Measures 293
Outbreak of Pea Aphid on Alfalfa 295
Injury to Apples by the Red Banded Leaf-Roller and its Control 298
The Raspberry Fruit Worm, Byturus unicolor Say, Injuring Strawberry Blossoms 302
The European Corn Borer in Connecticut 303
Infestations of 1925 303
Extension Work 307
Summary of 1925 Work 308
Further Notes on the Asiatic Beetle 309
Tests and Observations Made in 1925 311
Tobacco Plants Severely Injured by Wireworms 312
Mosquito Control Work in Connecticut 315
The Work by Towns 317
Miscellaneous Insect Notes 321
A Scale Insect New to Connecticut 321
Birch Twig Gall 321
Lace-Bugs Injuring Elm Foliage 321
Conservatory or Asiatic Camel Cricket in Connecticut 321
Borer in Willow Twigs 321
Abundance of Cherry and Pear Slug 322
Abundance of Grasshoppers 322
European Pine Mite in Connecticut 322
Sawfly Larvae Feeding upon Rudbeckia, "Golden Glow" 323
Noctuid Larvae Injuring Young Apple Trees 324
The Rose Stem Girdler in Connecticut 324
Pears Injured by Quince Curculio 324
Tobacco Injured by Tipulid Larvae 325
Syrphid Eggs and Larvae on Apple 326
Index 328

AUTHORSHIP

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ILLUSTRATIONS

The illustrations in this Bulletin are from the following sources: Figs. 38, 39 and 40 reproduced from printed blanks; Fig. 41, map drawn by Alex. Cahn and shaded by Stoddard Engraving Co.; Figs. 42, 43, 44, 47, 48 and 50 from drawings by Dr. Philip Garman. Fig. 49 drawn by Mr. R. B. Friend. Fig. 45 from photograph by Mr. B. H. Walden. Fig. 46 reproduced from city map. Plates are all from photographs: I, II, III, a, IV, b, V, a, and XII, b, by Dr. W. E. Britton; VI and XX, a, by Dr. Philip Garman; X by Mr. J. L. Rogers; XIV, XV and XVI by Mr. R. C. Botsford; all others by Mr. B. H. Walden.

BULLETIN 275

TWENTY-FIFTH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I have the honor to transmit, herewith, my twenty-fifth annual report as State Entomologist of Connecticut. As in former years, this report fully covers the activities of the Department of Entomology, as regards the inspection and control work provided for by Statute, and also the various lines of research and observation dealing with economic entomology.

Respectfully submitted,

W. E. Britton,
State and Station Entomologist.

INSECT PEST ACCOUNT

Report of Receipts and Expenditures of the State Entomologist

From July 1, 1924 to June 30, 1925.

Receipts

Insect Pest Appropriation	$15,000.00	
Insect Pest Appropriation, Added by Board of Control	104.22	
Balance on hand July 1, 1924	2,704.52	
		$17,808.74

Expenditures

Salaries	$11,982.02
Labor	2,374.56
Stationery and Office Supplies	228.63
Scientific Supplies (Chemicals)	31.67
Scientific Supplies (Other laboratory supplies)	82.87
Scientific Supplies (Photographic)	81.25
Lumber and Small Hardware	.71

Miscellaneous Supplies*	$544.19	
Automobile Oil	4.15	
Telegraph and Telephone	6.00	
Postage	40.60	
Travel (Outlying Investigations)	294.87	
Travel (Meetings, etc.)	185.97	
Travel (Gasoline for automobiles)	240.14	
Freight, Express and Parcels Post	14.09	
Publications (Bulletins, etc.)	40.53	
Furniture and Fixtures (New)	15.70	
Furniture and Fixtures (Repairs)	14.00	
Library (Books and periodicals)	55.38	
Library (Binding)	7.50	
Scientific Equipment (New)	116.75	
Live Stock (Bees)	1.00	
Tools, Machinery and Appliances (New)	102.60	
Tools, Machinery and Appliances (Repairs)	8.45	
Automobiles (New)	595.50	
Automobiles (Repairs)	349.73	
New Buildings and Structures	35.77	
Insurance (Automobile)	121.29	
Miscellaneous Contingent Expenses	40.00	
Total Disbursements		$17,615.92
Balance in hands of State Comptroller, June 30, 1925		192.82
		$17,808.74

SUMMARY OF INSPECTION AND OFFICE WORK

210 samples of insects received for identification.
160 nurseries inspected.
151 regular certificates granted.
6 special raspberry certificates granted.
57 dealers' permits issued.
107 shippers' permits issued to nurserymen in other States.
143 duplicate certificates furnished to be filed in other States.
118 parcels of nursery stock inspected and certified.
47 bales of mountain laurel and willow (14 trips) inspected and certified for shipment into New York.
112 orchards and gardens examined.
27 shipments, containing 277 cases, 2,977,346 plants, imported nursery stock inspected.
18 shipments, or 66 per cent. found infested with insects or fungi.
766 apiaries, containing 8,257 colonies, inspected.
19 apiaries and 42 colonies found infested with European foul brood.
26 apiaries and 38 colonies found infested with American foul brood.
3,063 letters written on official work.
255 circular letters.
266 post cards.
46 reports to Federal Horticultural Board.
2,504 bulletins, etc., mailed on request or to answer inquiries.
45 packages sent by mail or express.
37 lectures and addresses at institutes, granges and other meetings.

* This includes fuel oil purchased for burning corn stalks and weeds around European corn borer infestations.

PUBLICATIONS OF THE ENTOMOLOGICAL DEPARTMENT, 1925

By W. E. Britton:

Twenty-fourth Report of the State Entomologist of Connecticut (Bulletin 265), 124 pages, 9 figures, 20 plates; 10,500 copies distributed in May.

Inspection of Nurseries in 1924, 8 pages, reprinted from the Report.

Better Care of Shade Trees, Tree Talk, Vol. 6, No. 4, page 4, February, 1925.

Fruit Insects—Important New Ones and Troublesome Old Ones, Report of 31st Annual Meeting, Massachusetts Fruit Growers' Association, Inc., January 7-8, 1925, pp. 118-131, distributed in April.

Report of Committee on Injurious Insects, Proceedings of 34th Annual Meeting, Connecticut Pomological Society, December 11-12, 1924, p. 46, published in 1925.

Recent Developments in Insect Control, Proceedings of 34th Annual Meeting, Connecticut Pomological Society, p. 48.

Insects Attacking Vegetable Crops in Connecticut in 1924, Report of Connecticut Vegetable Growers' Association, p. 43.

The New Law Providing for the Registration and Inspection of Nurseries, Special Bulletin, 500 copies, July 1925.

Regulations Concerning the Shipment of Nursery Stock and the New Law, Bulletin of Immediate Information No. 50, July, 1925.

European Corn Borer Here—Will You Co-operate? Leaflet used in clean-up work around infestations, 6,000 copies, October, 1925.

Regulations Concerning the Transportation of Nursery Stock in the United States and Canada, Bulletin of Immediate Information No. 51, 24 pages, 2,500 copies, October 1, 1925.

By W. E. Britton, G. P. Clinton and W. O. Filley:

Second Report of the Tree Protection Examining Board (Bulletin 263), 52 pages, 8 plates, March, 1925.

By Philip Garman:

Notes on Bee Diseases in Connecticut, Journal of Economic Entomology, Vol. 18, p. 445, June, 1925.

A New Genus and Species of Trombidiidae, Journal New York Entomological Society, Vol. xxxiii, p. 85, June, 1925.

The Oriental Peach Moth Problem, Proceedings of 34th Annual Meeting, Connecticut Pomological Society, p. 57.

By R. B. Friend:

Experience with Baited Traps in Controlling Cabbage Maggots, Report of Connecticut Vegetable Growers' Association for 1924, p. 50.

DEPARTMENT STAFF AND WORK

W. E. Britton, Ph.D., *State and Station Entomologist.*
B. H. Walden, B.Agr., *Photographic and General Work.*
M. P. Zappe, B.S., *Inspection and General Work.*
Philip Garman, Ph.D., *Research Work.*
} *Assistant Entomologists.*
Roger B. Friend, B. Sc., *Graduate Research Assistant.*
John T. Ashworth, *Deputy in Charge of Gipsy Moth Work.*
James A. McEvoy, *Assistant in Gipsy Moth Work.*
Robert C. Botsford, *Deputy in Charge of Mosquito Work.*
Miss Gladys M. Finley, *Clerk and Stenographer.*
H. W. Coley, Westport,
A. W. Yates, Hartford,
} *Apiary Inspectors.*

There has been no change in personnel of the regular staff since the last Report. Mr. Walden has continued to act as chief photographer of the Department, has taken charge of the office during the absence of the Entomologist, has assisted in scoring fruit in the experiments in spraying and dusting, and has continued his researches on the imported currant worm, *Pteronidea ribesi* Scop.

Mr. Zappe has continued to have charge of the inspection of nursery stock, and of scouting and clean-up work in co-operation with the Federal Bureau of Entomology, on account of the European corn borer. He has collaborated with Dr. Garman in the study of the plum curculio in apple orchards and on the life history and control of the Asiatic beetle, *Anomala orientalis;* with Mr. E. M. Stoddard of the Botany Department in making further tests of various dusts and sprays to control pests of apple orchards, and in making orchard surveys with a view to determining the proper time and materials for treatment.

Mr. J. Leslie Rogers was employed to assist in nursery inspection from July 1 and after the nurseries were completed, was continued on European corn borer clean-up work, during the remainder of the calendar year. Mr. Gerald T. Thompson likewise helped in inspecting nurseries until September 15, when he returned to College. Dr. W. R. Hunt of the Botany Department also assisted in nursery inspection, paying particular attention to plant diseases.

Dr. Garman has continued his investigations on the Oriental peach moth; treatment for the American foul brood of bees; and has made further observations on the European red mite. Jointly with Mr. Zappe, he has continued the investigations on the five-year program begun in 1922, of the plum curculio in apple orchards, and some attention has been given to the Asiatic beetle. Dr. Garman has constantly revised his manuscript on the Odonata or dragonflies of Connecticut, which for some time has been ready, and will later be published as a bulletin of the State Geological and Natural History Survey.

Mr. Friend, who is taking graduate work for the doctorate in Yale University, has continued his studies on the bionomics of the birch leaf skeletonizer, and jointly with the Entomologist has made observations on the imported birch leaf-miner, *Fenusa pumila* Klug., from Europe. Mr. Friend has also given considerable attention to several insects attacking vegetable crops.

The gipsy moth control work has been prosecuted vigorously as in past years by Deputy John T. Ashworth and his Assistant, James A. McEvoy, with headquarters at Danielson. This work is conducted in co-operation with the Federal Bureau of Entomology.

Mr. Botsford has continued to serve as Deputy to Director Slate in charge of mosquito elimination work.

Messrs. A. W. Yates, Hartford, and H. W. Coley, Westport, have continued to inspect apiaries, as in past seasons, on a *per diem* basis.

Miss Finley has continued to perform the necessary clerical and stenographic work of the Department.

The Entomologist has directed the work of the Department and attended to the correspondence of the office; jointly with Mr. Friend he has studied the imported birch leaf-miner; he has continued to serve as Associate Editor of the Journal of Economic Entomology, as Insect Pest Reporter in Connecticut for the Insect Pest Survey of the Bureau of Entomology, and as Chairman of the Tree Protection Examining Board. In October, he was also appointed Superintendent of the State Geological and Natural History Survey.

The more important activities of the Department are described in the various papers in the following pages of this Report.

ENTOMOLOGICAL FEATURES OF 1925

The early part of the season of 1925 was fairly cool and moist and not favorable for plants that thrive best at high temperatures. The first week in June was fair and very hot, and following this period leaf scorch was evident on some kinds of vegetation. After this hot week it was fairly cool for the remainder of the season, with only light rains until September.

One of the outstanding features of the season was the great increase in the Oriental peach moth. The gipsy moth has not spread and the towns of Cheshire and Wallingford have been removed from Federal quarantine. Not a single nest of the brown-tail moth has been seen in Connecticut since 1919.

In order to obtain accurate data regarding the seasonal development of fruit trees and their pests and especially the presence or absence of the latter, Messrs. Zappe and Stoddard made regular visits during May and June to a number of orchards in each county of the State. In all, 39 different orchards were visited; three or four visits were made to certain orchards and 62 visits were made altogether. The data gathered in these visits is used herein.

Fruit Insects

The Oriental peach moth, *Laspeyresia molesta* Busck., was very abundant in some of the orchards in New Haven County and much wormy fruit was the result. One orchard had nearly 50 per cent. of wormy fruit. The pest was not any more abundant in Greenwich than in 1924, but was much more destructive in some

parts of New Haven County. The distribution of this insect in the State has not been fully investigated, but it seems not yet to be present around Storrs or in the eastern portion of the State. Where abundant, its control is a serious problem and is discussed on page 280 of this Report.

The European red mite, *Paratetranychus pilosus* C. & F., was unusually troublesome at Conyer's Farm, Greenwich, and did some damage at Branford, Wallingford and Middlefield. In Branford and Wallingford the mite injured McIntosh, and this is the first time we have ever seen brown leaves on this variety from the attacks of the mite. Some eggs were present on apple at Cheshire, April 2, Milford April 17, Southington April 21, Middlefield April 23, and on European plum at Hazardville, April 7. The best control measure consists in applying a late dormant spray of miscible oil (1-15) to kill the eggs, but failing to give this treatment, persistent spraying of the foliage in summer with dilute lime-sulphur will usually kill enough of the young mites to hold the pest in check.

Work of the pear leaf blister mite, *Eriophyes pyri* Nal., was observed at West Hartford, May 19, and a severe infestation on Bartlett and Seckel was seen at Bantam on May 22. A late dormant spray of lime-sulphur or miscible oil will usually control this pest.

The red-banded leaf-roller, *Eulia velutinana* Walker, was abundant in some orchards and caused considerable injury to fruit as described on page 298. Apparently this pest may be controlled by lead arsenate sprays or dusts as per regular schedule, with an extra application about August 1, in severe infestations.

The apple and thorn skeletonizer, *Hemerophila pariana* Clerck., attracted little attention during the season, though traces of it could be found in nearly every orchard, and the little moths were quite abundant at the Station.

The bud moth, *Tmetocera ocellana* Schiff., was not very troublesome in orchards in 1925, though a few specimens were noticed in Southington May 5. Early applications of lead arsenate will prevent injury.

The red-humped caterpillar, *Schizura concinna* S. & A., was received at the Station from Beacon Falls, August 1, Danbury August 4, Thomaston and Torrington August 19. These caterpillars feed in clusters and strip the leaves from young apple trees in orchard and nursery. Spraying with lead arsenate will prevent defoliation.

The tent-caterpillar, *Malacosoma americana* Fabr., was abundant all over the State, but was seemingly less abundant than elsewhere in Hartford County, particularly in the towns of Simsbury, Windsor, East Hartford, South Windsor and East Windsor. At Wilton, April 20, the young caterpillars had been killed soon after hatching, where a lime-sulphur spray had been applied.

The codling moth, *Carpocapsa pomonella* Linn., still continues to be one of the leading apple pests throughout the State. It is against this insect that arsenical poisons were first used on the apple, and it is the chief reason for their continued application.

The pear psylla, *Psylla pyricola* Foerster, continues to be troublesome wherever pears are grown. Eggs were abundant at Deep River, April 9, and at Southington, April 21-23. The nymphs were killed at Farmington by a spray of lime-sulphur (1-40). None were found in one Wallingford orchard where a delayed dormant miscible oil spray was applied.

Seckel pears in the writer's garden were injured for the first time by curculio larvae. Though the adult has not yet been reared, the injury has been ascribed to the quince curculio, *Conotrachelus crataegi* Walsh, and is described more fully on page 324 of this Report.

Fall cankerworms, *Alsophila pometaria* Harr., were present in abundance and caused injury in many localities. We had occasion to observe them in New Haven, and eggs were seen in East Haven February 19, and in Groton and North Stonington April 9. The caterpillars attack not only fruit trees but also shade and forest trees. The trees on the Station grounds were banded in the fall of 1924, and as these bands were kept in a sticky condition during the emergence of the adults, and at the time when the eggs hatched, the foliage was scarcely mutilated and was not injured. Spraying with lead arsenate early in May will prevent defoliation.

An unusual form of injury was reported from Danbury, May 16, where small flea-beetles were defoliating young peach trees. The species responsible for the injury has green wing-covers, reddish-brown thorax, and has been identified as *Crepidodera rufipes* Linn. Of course trees may be protected by a spray of lead arsenate.

The grapevine flea-beetle, *Altica chalybea* Illiger, injured grapevines at Highwood in April by eating holes into the buds. (Plate IX, b.)

The bumble flower beetle, *Euphoria inda* Linn., was received from Danbury on May 20 and June 5, where it was said to be injuring trees and in one instance it was thought to be the gipsy moth. As a rule the beetles feed upon decaying fruit later in summer and we have no records of their injuring the tissues of trees.

The plum curculio, *Conotrachelus nenuphar* Hbst., was responsible for much injury to apples on unsprayed trees at North Stonington June 11, and at Woodstock June 12. Also in Groton, Montville and Lebanon June 11, all fruit on trees near fences and next to woodland was injured and infested by many larvae. Apples injured by this insect were noticed at Wallingford June 4, Pomfret June 12, Waterbury July 22, East Granby August 18; also on apples and peaches at Rockville June 5, and on cherries at New Britain June 15. The characteristic scars on the fruit were

noticed in the experiments in spraying and dusting in Milford and at the Station orchard at Mount Carmel. The control of this pest is treated more fully on page 286 of this Report, but apparently lead arsenate sprays applied at the time of the pink, calyx, 7-day and 14-day treatments will in most cases produce 90 per cent. of clean fruit in apple orchards, though where possible all rubbish where the beetles hibernate should be removed.

In May, Mr. Walden investigated a case in South Glastonbury where there was a 10 to 15 per cent. injury to strawberry plants by the raspberry fruit worm or raspberry beetle, *Byturus unicolor* Say, described on page 302 of this Report.

Strawberry plants in Coventry, Bolton and Simsbury were injured in May by cutworms eating the leaves. Mr. Walden visited Simsbury and has described the injury elsewhere in this Report.

The apple maggot, *Rhagoletis pomonella* Walsh, continues to be troublesome in many orchards, and infested fruit was received from Waterbury July 22, and from Danbury October 6. It may be controlled by late applications of lead arsenate, about July 4 and July 20.

The rosy apple aphid, *Anuraphis roseus* Baker, was not very abundant in most apple orchards, but was observed in Cheshire May 27, and there were a few in Pomfret and Woodstock on June 12, and in East Granby August 18. It was very bad on one tree in an orchard at Hazardville June 5.

The green apple aphid, *Aphis pomi* DeGeer, was observed in many orchards in spring and early summer. There were very few at Litchfield, Bantam and Cornwall, April 22, at Wallingford, Middletown and East Hampton, April 23, at Cheshire May 27, at Greenwich May 14, at South Glastonbury May 5, at Wallingford June 4, and at Woodstock June 12. They were abundant at Southington April 2, 31 being counted on one bud; at Rockville April 7, Milford April 17, Wilton April 20, Deep River April 9, and on unsprayed tree, Durham, and Southington, May 5, and very abundant at North Stonington June 11. The species was observed also in Cheshire, Southington and Newington April 21, New Haven April 22, Middlefield April 23, Greenwich March 31, North Stonington April 9, and at Farmington May 6, where a spray of nicotine sulphate had knocked off many of the aphids which were still alive and crawling on the ground. At Southington May 5, aphids were abundant where lime-sulphur was applied as a dormant spray, but there were few where miscible oil had been used. Also at Yalesville, aphids were present on McIntosh trees which had been sprayed with lime-sulphur (1-8), nicotine sulphate, and Kayso, but were few where a dormant spray of miscible oil had been applied.

The green peach aphid, *Myzus persicae* Sulzer, was present on peach trees in some localities and caused the leaves to curl. There

were few in Cheshire May 27, and though abundant in Rockville, by June 5 all had been cleaned up by natural enemies. In one orchard in Highwood on May 22, the leaves on inside fruit clusters had been badly curled and those on terminal branches were uninjured. Syrphid larvae and lady beetles were abundant, and though we suggested a nicotine dust application for the aphids, could hardly recommend it.

The oyster-shell scale, *Lepidosaphes ulmi* Linn., is one of the commonest pests found in nurseries and is present in many apple orchards. It is usually about the same color as the bark on which it rests, and in shape is elongate, broader at one end than the other, and often curved. Though it occurs on apple, it also infests many shade and woodland trees and seems to prefer poplar, willow, birch, ash, butternut and lilac in Connecticut. There is only one generation each year and it passes the winter in the form of oval white eggs under the old shells on the bark. A spray of nicotine sulphate early in June soon after the eggs hatch is a good remedy.

The San José scale, *Aspidiotus perniciosus* Comst., is more prominent than five or 10 years ago, particularly on untreated trees and shrubs in protected places. It was observed at East Haven February 19, on cherry at Milford August 5, and in West Haven October 14. Orchard trees in Connecticut which are sprayed regularly or occasionally with lime-sulphur or with miscible oil do not become seriously infested.

Young pear and apple trees are occasionally injured by a whitish pear-shaped scale known as the scurfy scale, *Chionaspis furfura* Fitch. This scale was noticed at East Haven February 19, by Mr. Zappe. There is one generation each year, and the species passes the winter as oval, purple eggs under the shells. These eggs hatch the last days of May and a spray of nicotine sulphate early in June is the proper remedy.

Vegetable Insects

In reviewing the vegetable insects of the season, we have the advantage of the observations of Mr. A. E. Wilkinson, Vegetable Specialist of the Connecticut Agricultural College at Storrs, who traveled all over the State and visited all the principal vegetable growing sections, and observed the pests and other conditions. Free use is here made of Mr. Wilkinson's reports.

Damage by cutworms was more prominent than usual in most localities, and was severe throughout the State on all kinds of vegetable crops. Reports of injury to vegetables were received from Middletown May 18, from Southington, Waterbury, Thomaston, Morris and Windsor, May 21; from South Norwalk, Easton, Weston, Danbury, Bethel, Brookfield and New Fairfield,

on June 5. In general, a poisoned bait of bran mash distributed about the field will prevent damage from cutworms.

The stalk borer *Papaipema nitela* Guen., was observed in many gardens. It was found in potato stalks at Woodbury, July 31, and was received in corn from Stratford, July 1, Thomaston July 7, Taconic July 21, and Yantic August 4. There is little to do except to remove and destroy the infested stalks.

The corn ear worm, *Chloridea obsoleta* Fabr., though not as abundant as usual, was reported from Mansfield in midsummer and received from East Hartford October 3, and on popcorn from Bridgeport November 3.

The European corn borer, *Pyrausta nubilalis* Hubner, which was discovered at seven points along the Connecticut shore in 1924, and cleaned up around each infestation, is still present in the State. The Federal scouts did not find it in all localities where it occurred last year, but found slight infestations at Bridgeport, Saybrook, New London and at several places in Groton and Stonington. Clean-up work was carried on, but on account of weather conditions could not be completed in Groton and Stonington until spring. This work is described more fully on page 303 of this Report.

The imported green cabbage worm, *Pontia rapae* Linn., was present as usual, though possibly less abundant. It was reported from Windsor May 21, and from Southport, Westport, Easton and Bridgeport on June 2.

The squash borer, *Melittia satyriniformis* Hubner, caused the usual amount of injury to squash and pumpkin vines.

The Colorado potato beetle, *Leptinotarsa decemlineata* Fabr., was not observed to be unusually abundant except on the Station Farm at Mount Carmel, where attention was not given at the proper time. Mr. Wilkinson reported only a few to be seen on June 4, when he visited plantations in South Norwalk, Easton, Weston, Danbury, Bethel, New Fairfield and Brookfield, but that both larvae and adults were plentiful at Southington, Buckland and Wapping on July 24. Of course spraying and dusting with lead arsenate is the remedy.

The cucumber or potato flea-beetle, *Epitrix cucumeris* Harr., was very abundant on potatoes and was also observed on tomatoes and egg-plants at South Norwalk, Easton, Weston, Danbury, Bethel, New Fairfield and Brookfield, June 4, and at Southport, Westport and Bridgeport on June 2. It was present on cucumbers at Windsor Locks, Plainville and Southington, May 21, and on potatoes at Southington, Buckland and Wapping July 24. Thorough spraying with Bordeaux mixture and lead arsenate is probably the best remedy in the field, but a few tomatoes or egg-plants in the garden may be protected by spraying with nicotine sulphate.

The common asparagus beetle, *Crioceris asparagi* Linn., and the twelve-spotted asparagus beetle, *C. duodecimpunctata* Linn., were

present in nearly all large asparagus plantations in the State. They were abundant at Riverton and Southington on May 21, and at South Norwalk, Easton, Weston, Danbury, Bethel, Brookfield and New Fairfield on June 5. The larvae or grubs of the former and the adults of both species feed upon the stems and foliage, but the larvae of the twelve-spotted species feed in the seed pods and do not seriously injure the plants. In severe infestations, the larvae and adults may be killed on the tall or mature plants, by spraying with lead arsenate forced with strong pressure through a nozzle with fine aperture. Nicotine sulphate may be sprayed upon the shoots if the beetles threaten to injure them.

The striped cucumber beetle, *Diabrotica vittata* Fabr., was present in about the usual numbers in most plantations and was controlled only with the usual difficulty. It was reported from Southport, Westport, Easton and Bridgeport, on cucumbers, squashes and melons on June 2. At the Station Farm it was abundant and several treatments were necessary to control the pest. In experiments conducted in various sections of the country, particularly on Long Island and in Canada, calcium arsenate and hydrated lime have given fairly good control, though occasional injury to plants resulted on Long Island. Sodium fluosilicate (1 part) and hydrated lime (9 parts), as well as calcium arsenate and gypsum (1-20), gave good results in Canada. Dr. H. C. Huckett on Long Island found that by mixing No. 2 wheat flour with hydrated lime or gypsum, equal parts, it reduced injury and increased adhesiveness. He also planted squash plants for traps near the cucumbers, then dusted the cucumber plants, thus driving the beetles upon the squash plants, which were then covered and exposed for three minutes to a treatment of four per cent. nicotine dust. This proved effective in destroying the beetles.

The cabbage maggot, *Hylemyia brassicae* Bouché, caused the usual amount of damage and in some localities early cabbages gave only about 50 per cent. of a crop on account of cabbage maggot and cutworms. Cabbage maggot was reported as abundant at Southington and Windsor, May 21; Bridgeport, Southport, Westport and Easton, June 2; Devon, Stratford, Shelton, Cannondale and New Canaan, June 3; South Norwalk, Easton, Weston, Danbury, Bethel, New Fairfield and Brookfield, June 5; Hampton, Canterbury, Brooklyn, Danielson, Pomfret, Woodstock, Norwich, Niantic, Lyme, Waterford, Ellington, Rockville, Vernon, Bolton, Coventry, Tolland, Somers, Stafford and Mansfield, June 12. The flies were noticed about radishes at Plainville, May 21. Mr. Friend observed this insect as severely infesting radishes at Cheshire, and in cabbages at Westport. Probably mercuric chloride or corrosive sublimate (1 ounce in 10 gallons water) is as good a remedy as any, but is known to retard the growth of the plants and consequently more fertilizer should be applied where this treatment is used. It is inadvisable to dip the young plants into

this mixture before setting. In the home garden where only a few plants are grown, tarred paper disks placed flat on the surface of the ground around each plant at the time of setting, will protect them from serious injury.

The spinach maggot or leaf-miner, *Pegomyia hyoscyami* Panzer, which also infests beet and "lamb's quarters," was present in about the usual abundance, though Mr. Friend did not find an infested field suitable for conducting control experiments. This pest was noticed by Mr. Wilkinson at Middletown, May 18, and on beets and spinach at Bridgeport, Southport, Westport and Easton, June 2.

The potato aphid, *Macrosiphum solanifolii* Ashm., was abundant in some sections of the State, and had seriously injured more than 100 acres of potatoes around Middletown by July 21. It was also observed at Stratford, Bridgeport, Westport and Trumbull, on July 19, where some of the vines had turned brown. On July 20, aphids were observed in Windham, Tolland and New London Counties, and on July 24, they were present in abundance at Southington, Buckland and Wapping. After the rain on July 31, few aphids could be found. Heavy applications of nicotine dust is perhaps the best artificial treatment.

The pea aphid, *Illinoia pisi* Kalt., was present in many fields, but on the whole it did not cause serious injury to peas in Connecticut in 1925. It was reported as being present at Green's Farms June 3, and at South Norwalk, Easton, Weston, Danbury, Bethel, Brookfield and New Fairfield, June 5. Around New Haven, several slight infestations were observed in pea plantations, but there was no serious injury brought to my attention. The same aphid caused considerable injury to fields of alfalfa as described on page 295 of this Report. In the home garden, dusting with nicotine is perhaps the best remedy.

The cabbage aphid, *Brevicoryne brassicae* Linn., was present at Middletown May 18, and at East Morris May 21, in both instances on plants from the south. A few were noticed by the writer on home grown plants around New Haven, but they afterward disappeared without doing much damage. Even a moderate infestation will prevent the plants from heading, and liberal applications of nicotine dust will control the aphids.

The turnip aphid, *Aphis pseudobrassicae* Davis, was absent from several turnip patches around New Haven, and no reports were received of injury caused by it.

The tarnished plant bug, *Lygus pratensis* Linn., was reported by Mr. Wilkinson as being very abundant on potatoes at Storrs on July 27. The remedy is to dust or spray with nicotine.

The onion thrips, *Thrips tabaci* Linde., was abundant at Westport, July 19.

The squash bug, *Anasa tristis* DeGeer, was found everywhere as usual. The over-wintering bugs are hard to kill except by crush-

ing, but the newly-hatched nymphs may be killed by a spray of nicotine sulphate.

Insects Attacking Field Crops

The army worm, *Cirphis unipuncta* Haworth, was present in some localities and caused considerable injury to timothy grass in Wallingford July 2, and in Milford July 20. Prompt cutting of the grass for hay was recommended as the best treatment in both cases.

White grubs which are the larvae of May or June beetles, *Phyllophaga* sp., were reported as injuring grasslands in a few localities. One report on September 23 of grubs injuring a lawn in Meriden was investigated, thinking it might prove to be the Asiatic beetle, but it was only common white grubs.

The Asiatic beetle, *Anomala orientalis* Waterhouse, which has recently become established in the Westville section of New Haven, caused more injury in the latter half of the summer than has ever been seen before. The grubs eat the roots of grass and thus far the injury has only appeared on lawns around private residences. A more detailed account of this pest may be found on page 309 of this Report.

There was severe injury from attacks of wireworms to newly-set tobacco plants under cloth in Windsor during the last of May. Similar damage was reported by about a dozen tobacco growers. A more detailed account of this outbreak will be found on page 312 of this Report. Mr. Wilkinson reported injury to cabbage plants by wireworms at Middletown, May 18, and at Windsor, May 21.

Alfalfa fields were attacked in Seymour, North Branford, Simsbury, East Windsor, Middletown and Woodbridge by the pea aphid, *Illinoia pisi* Kalt., and a more detailed account is given on page 295 of this Report.

Shade and Forest Tree Insects

The larch leaf-miner or case bearer, *Coleophora laricella* Hubn., was observed in a few places, and specimens were received from Rainbow, May 13. Probably it was less destructive than in 1923 and 1924.

The cottony maple scale, *Pulvinaria vitis* Linn., was received from Hartford on maple, June 29 and July 16.

The tulip tree scale, *Toumeyella liriodendri* Gmel.. was received from North Stonington August 28. Two small tulip trees on the Station grounds became infested and were sprayed with commercial liquid lime-sulphur (1-9) in October 1923. This cleaned off most of the infestation but a few scales were present one year

later and the trees were sprayed with one of the miscible oils, and are now clean.

The pit-making oak scale, *Asterolecanium variolosum* Ratz., was received from New Haven December 4, on oak. This scale usually occurs on golden or English oak, *Quercus robur,* and a pit or depression is found in the bark under and around each scale.

The woolly maple leaf scale, *Phenacoccus acericola* King, occasionally causes injury to sugar maple trees, and specimens were received from New Haven on September 30. The large woolly or cotton-like wax masses are found on the under sides of the leaves in midsummer, and contain the mature females and eggs or newly-hatched young. The immature females and the male cocoons are much smaller and occur in the cracks and crevices of the bark of the trunk and lower branches throughout the winter. Spraying in March with lime-sulphur and nicotine has proved to be a satisfactory treatment.

The pine leaf scale, *Chionaspis pinifoliae* Fitch, was received from Southington March 5, Greenwich March 26, Meriden September 24, and Wethersfield October 3. There are two generations each year and two or three applications of nicotine sulphate between June 1 and August 15 should keep this pest in check.

The hickory leaf-stem gall aphid, *Phylloxera caryaecaulis* Fitch, causes certain trees to become very unsightly by forming galls on the petioles of the compound leaves, which often turn brown and drop in midsummer. Specimens were received from Ridgefield June 11, and from Danbury August 21. Though we have conducted no tests for the control of this aphid, probably a spray of miscible oil or lime-sulphur before the buds open would kill the overwintering females or eggs.

A wooly aphid on maple, *Neoprociphilus aceris* (Monell), was received from New Haven, June 22.

The spruce gall aphids, *Chermes abbietis* Linn., on Norway spruce, and *Chermes cooleyi* Gillette, on Colorado blue spruce, seem to be more abundant than was the case a few years ago. The former was received from Marion June 10, Vernon June 16, and from Meriden September 24; the latter from Greenwich March 24, Pine Orchard July 24, and from Norfolk August 8. These pests are found in many of the nurseries and are mentioned on page 237 of this Report. Spraying the trees in April with nicotine sulphate or with a miscible oil will kill the overwintering females before the eggs are laid.

The fall web-worm, *Hyphantria cunea* Drury, was about as abundant as usual in late summer and made its nests on the ends of branches of all kinds of fruit, shade and woodland trees. Apparently it was more abundant than usual in New London County. The only specimens received were from New Haven, August 20. The remedies are to clip off and burn the nests or crush the caterpillars, or spray with lead arsenate.

A small Scolytid beetle, thought to be *Ips pini* Say, was received from Hazardville May 26, tunneling in pine bark.

Sawfly cocoons are often found on pine twigs, and those of the imported pine sawfly, *Neodiprion simile* Hartig, were received from Greenwich March 26, and larvae and pupae of *Neodiprion pinetum* Norton, on red pine were received from Danbury, October 30.

Work of the poplar and willow curculio, *Cryptorhynchus lapathi* Linn., was received from Thompsonville, September 8.

The spruce mite, *Paratetranychus ununguis* Jacobi, was injurious to spruce trees about New Haven and specimens were received from Milford May 23, Stamford July 20, and Meriden September 24. One of the best remedies is a spray of linseed oil emulsion.

The maple bladder gall caused by a mite, *Eriophyes quadripes* Shimer, is seen each year on the leaves of silver maple, and during 1925 specimens were received from Collinsville, June 10, Hartford, June 29, Westport, July 21, and Somers, August 13.

The imported birch leaf-miner, *Fenusa pumila* Klug, now occurs all over Connecticut on gray birch, particularly on young sprouts. Specimens were received from Yalesville, July 15, Leete's Island, July 30, and Norfolk, August 8.

The imported willow leaf-beetle, *Plagiodera versicolora* Laich., which first appeared in the State in Greenwich, has now spread nearly all over Connecticut. Specimens were received from West Haven August 20, and while inspecting nurseries Mr. Zappe observed the presence of this insect in Greenwich, August 11 and 14, Stamford, August 29, New Canaan, August 3, Ridgefield, September 9, and Bristol, September 8.

The elm leaf beetle, *Galerucella xanthomelaena* Schrank, was present and there were many localities where the unsprayed trees were brown in late July and August. Specimens were received from Middlebury, July 16. In many villages the elm trees were sprayed and the foliage kept green throughout the season.

The birch leaf skeletonizer, *Bucculatrix canadensisella* Chamb., though perhaps not so abundant as in 1923 and 1924, was present and caused many areas of gray birch to become brown in late summer.

Household Insects

Nearly every season a certain number of specimens of insects infesting stored food products in or about the household are sent to the Station, and some of those received in 1925 are mentioned here.

The Oriental cockroach, *Blatta orientalis* Linn., was received from Danbury, February 2, and the German cockroach or croton bug, *Blatella germanica* Linn., from Cheshire, April 1. Both species are found in homes, especially around the kitchen and pantry and along the water pipes. Commercial roach powders are now sold everywhere.

The black carpet beetle, *Attagenus piceus* Oliv., is a common pest in houses where the larvae live in floor cracks and feed upon the lint, and the adult beetles eat holes in clothing in closets. Filling or frequent cleaning of the cracks is advisable. Small pieces of woolen cloth placed on the floors in closets will often be eaten instead of the clothing. Specimens of this insect were received from New London, June 10, and from Milford, October 23.

The common carpet beetle or "buffalo bug," *Anthrenus scrophulariae* Linn., was received from Waterbury, October 24. This also injures clothing and particularly carpets on floors. Carbon tetrachloride may be used on infested carpets, or heat generated by applying moisture and going over the carpet with hot flatirons.

The common clothes moth, *Tineola bisselliella* Hummel, was received from New Haven, May 23. Clothes which are worn or moved frequently are usually not injured, and if hung out in the sun about once a month, there is little danger of injury. If this cannot be done, they should be stored at a low temperature, put in moth-proof bags, or packed in naphthalene or camphor.

The granary weevil, *Calendra granaria* Linn., in poultry feed was received from New Haven, September 17; the Mediterranean flour moth, *Ephestia kuehniella* Zeller, in wheat flour from Waterbury, July 17, and the drug store beetle, *Sitodrepa panicea* Linn., in stored grain from New Haven, June 25. These insects are common pests of stored food products, and may be controlled by fumigating or heating the infested products.

The common white ant, *Reticulitermes flavipes* Koll., was received from New Haven, April 17, where it infested the structural wood around the base of a veranda; also the clover mite, *Bryobia praetiosa* Koch, was reported as crawling about on a house in New Haven, May 8.

Miscellaneous Insects

The box leaf-miner, *Monarthropalpus buxi* Labou., was received from Green's Farms, March 16. This is a serious pest of box and has also been recorded from Waterford.*

The juniper web-worm, *Dichomeris marginellus* Fabr., was received from Manchester and West Haven, on June 5, where the caterpillars had injured junipers by webbing the leaves together and feeding upon them inside the web.

Convention of Entomological Workers

The second convention of Entomologists working in Connecticut was held at the Station on October 30, 1925. The pro-

* Report for 1923, page 312.

gram was varied from that of last year by securing addresses from a few men working outside the State on problems which are or threaten soon to become Connecticut problems. Thus we had Mr. L. B. Smith and Dr. Alvah Peterson from New Jersey and Dr. H. C. Huckett from Long Island. Though the attendance was somewhat smaller than last year, there was great interest shown and all present seemed to feel that it had been a successful and interesting meeting. The following program was fully carried out:

PROGRAM

A. M.

Greetings.
W. L. Slate, Jr., Director, New Haven, Conn.

10:15 Notes on the Birch Leaf Skeletonizer.
R. B. Friend, Assistant Entomologist, New Haven, Conn.

10:45 The Asiatic Beetle in Connecticut in 1925.
M. P. Zappe, Assistant Entomologist, New Haven, Conn.

11:15 The Corn Borer Survey of 1925.
L. H. Worthley, In Charge of Control Work, Arlington, Mass.

P. M.

12:30 Luncheon.

1:30 The Japanese Beetle Survey of 1925.
Loren B. Smith, Entomologist in Charge, Riverton, N. J.

2:15 Gipsy Moth Survey of 1925.
A. F. Burgess, In Charge, Melrose Highlands, Mass.

3:00 Progress in Controlling Curculio on Apple in 1925.
Dr. Philip Garman, Assistant Entomologist, New Haven, Conn.

3:30 Cucumber Beetles.
Dr. H. C. Huckett, Research Associate, N. Y. Experiment Station, Long Island Branch, Riverhead, N. Y.

4:00 Oriental Peach Moth Survey.
Dr. Alvah Peterson, Bureau of Entomology, Riverton, N. J.

4:30 Anti-Mosquito Work of the Season in Connecticut.
R. C. Botsford, Deputy In Charge, New Haven, Conn.

4:45 The Birch Leaf-Miner in the Northeastern States.
Dr. W. E. Britton, State Entomologist, New Haven, Conn.

The following were present: A. F. Burgess, S. S. Crossman, H. L. Blaisdell, T. H. Jones, Melrose Highlands, Mass.; H. A. Ames, Bound Brook, N. J.; S. E. May, Canaan, Conn.; F. C. Rich, Ansonia, Conn.; L. H. Worthley, T. M. Cannon, Arlington, Mass.; Loren B. Smith, J. Peter Johnson, Riverton, N. J.; H. C. Huckett, Riverhead, N. Y.; J. A. Manter, E. W. Nelson, R. S. Filmer, P. E. Bilgood, L. A. Gilbert, J. G. Conklin, Storrs, Conn.; O. W. Spicer, Stamford, Conn.; G. M. Codding, Mount Vernon, N. Y.; P. H. Meagher, Wallingford, Conn.; C. L. Marshall, Meriden, Conn.; D. W. Thomas, 2d, Highwood, Conn.; G. A. Clyne, Waterbury, Conn.; Allen Latham, Norwichtown, Conn.; J. T. Ashworth, Danielson, Conn.; P. L. Buttrick, W. O. Filley, W. L. Slate, Jr., W. E. Britton, Philip Garman, B. H. Walden, M. P. Zappe, R. B. Friend, R. C. Botsford, Leslie Rogers, New Haven, Conn.; Alvah Peterson, Riverton, N. J.

INSPECTION OF NURSERIES IN 1925

The General Assembly of 1925 enacted a new law defining nurseries and nursery stock and providing that all nurserymen register and apply for an inspection each year before July 1; that all dealers register prior to March 1 each year and receive a permit; that all nurseries outside the State wishing to ship nursery stock into Connecticut file copies of their valid inspection certificate and receive permits allowing them to ship stock into Connecticut. The new law is as follows:

The New Law Providing for the Registration and Inspection of Nurseries

Chapter 265, Public Acts of 1925

Section 1. Inspection and Shipment of Nursery Stock: The state entomologist or his deputies or assistants shall, upon application, inspect at least once each year all nurseries at which woody field-grown trees and plants shall be grown for sale or shipment; may inspect any nursery stock when dug, before shipment or at destination; may inspect nurseries at any time for the purpose of controlling plant pests or to ascertain whether such pests exist in nurseries; may employ such deputies or assistants as he may deem necessary; may prescribe forms for registration, certificates and permits and may make rules and regulations regarding time and methods of inspection; may destroy or treat or order the destruction or treatment of, and prohibit the movement of, plants infested with dangerous pests; may co-operate with agents of the United States Department of Agriculture in the inspection of nurseries and control of plant pests; may, at reasonable times, enter any public or private grounds in performance of his duties under the provisions of this act. In case orders shall be issued for the destruction or treatment of infested plants, the owner, manager or agent of the nursery shall, within a reasonable time from the date of such order, destroy such plants as shall be ordered destroyed and make such treatment within the time specified in the order, or be subject to the penalty provided in section five of this act.

Sec. 2. All nurserymen shall register with the state entomologist each year, on or before July first, and make application for inspection, and furnish such data on such blanks as the state entomologist shall prescribe and furnish. In case a nurseryman shall fail to make such application on or before July first, he shall pay to the state entomologist the cost of such inspection. All firms, stores and individuals who shall sell but shall not grow nursery stock, shall be classed as dealers, and shall, each year, on or before March first, register with the state entomologist, giving the chief sources of their nursery stock and such data as he may require, on such forms as he may prescribe and furnish, and the state entomologist may issue a permit allowing such dealer to sell such nursery stock. Each nursery outside the state, before shipping nursery stock into the state, shall file with the state entomologist a copy of a valid inspection certificate and the state entomologist may issue a permit allowing such nursery to ship stock into the state. The state entomologist shall keep a record of all money received as costs for inspection, and such money shall be deposited with the state treasurer.

Sec. 3. The state entomologist shall issue to regular nurseries certificates, valid until the first day of August following the date of issue and covering

the stock inspected and such other stock as shall have been received under valid certificates of inspection; may issue temporary permits covering certain portions thereof, and permits to dealers. All such certificates and permits may be revoked for cause. Nursery stock which shall not have been inspected or stock from a nursery not holding a valid certificate of inspection shall not be sold or transported, and transportation companies shall refuse to accept any shipment not bearing such certificate or some form of permit issued by the state entomologist, and all nurserymen shall furnish a certificate, and all dealers a permit, to accompany each package of stock sold or transported, but no provision of this act shall prevent or render liable any individual or firm who shall transport stock from his field or property to another field or property belonging to or operated by him, when such stock is not to be immediately sold or offered for sale and when such transportation shall not violate any established federal or state embargo or quarantine regulations.

SEC. 4. For the purposes of this act, any place at which hardy trees, shrubs and vines shall be propagated or grown out of doors for commercial purposes, shall be considered a nursery, and such stock shall be regarded as nursery stock; hardy herbaceous perennial plants, including strawberry plants, may be subject to the same provisions regarding inspection and pest control, if, in the opinion of said state entomologist, it shall seem desirable to control the movement of such plants. Florists' ordinary plants, unless woody and field-grown, shall not be included.

SEC. 5. Any person who shall interfere with the state entomologist or his deputy or assistant in the performance of his duties under the provisions of this act, or any person, firm or corporation who shall violate any of the provisions hereof, shall be fined not more than fifty dollars. Any person aggrieved by any order issued under the provisions of this act may appeal to the superior court, or to any judge thereof if said court shall not be in session, and said court or such judge may grant such relief or issue such order or judgment in the premises as to equity may appertain.

SEC. 6. Section 2119 of the general statutes is repealed.

(Approved June 24, 1925.)

As this act gives the State Entomologist authority to make rules and regulations and to prescribe forms for certificates and permits, the following regulations have been adopted and were printed together with the law as Bulletin of Immediate Information No. 50, under date of July 15, 1925, and a copy sent out with each certificate and permit issued. The forms for certificate and permits are included here for reference. The regulations are as follows:

NURSERY CERTIFICATES

The original certificate issued by the State Entomologist under Chapter 265, Public Acts of 1925, is to be kept in the nurseryman's possession, and is not to be attached to any package of nursery stock. It applies to the whole nursery which has been inspected and to such purchased stock as has been received from other nurseries under the certificate of a state or government officer. If any stock is received from outside the state unaccompanied by such a certificate, the State Entomologist should be notified at once so that it may be inspected.

An exact transcript of the certificate including number and date may be printed on labels or tags for shipping and must be attached to each package sent out of the nursery. An additional statement, made by the owner, that the stock has been fumigated, will be required in many states. The law now requires that the inspection certificate be attached to every package shipped to points both within the State of Connecticut and outside. Please see that a copy always accompanies each sale whether shipped by freight, express, mail, automobile or whether carried away by the purchaser.

After the date of expiration, which is a part of each certificate, the document becomes invalid and should not be attached to any box, bale or package. The nurseryman has no right to change the date or any other portion of the certificate.

OFFICE OF STATE ENTOMOLOGIST

STATE OF CONNECTICUT

NEW HAVEN CONN.

No. _____ Date_____192

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NURSERY INSPECTION AND REGISTRATION

CERTIFICATE

This is to Certify that_____

of_____Conn., has registered as a Nurseryman, that the nursery stock has been duly examined in compliance with the provisions of Chapter 265, of the Public Acts of 1925, and that it is apparently free from dangerously injurious insects and plant diseases.

This certificate expires August 1, 192____.

_____

State Entomologist

FIG. 38.—Facsimile of nursery inspection and registration certificate, less than two-thirds size.

The improper use or abuse of a certificate will not be tolerated, and the certificate may be revoked for cause.

Duplicate copies of certificates for filing in other states will be furnished on request of the nurseryman.

DEALER'S PERMITS

The original permit issued by the State Entomologist under Chapter 265, Public Acts of 1925, should be kept in the dealer's

possession and is not to be attached to any package or shipment of nursery stock, though copies may be made for this purpose. These may be typewritten or printed and a copy must go with each separate sale from stores, and with each shipment or package of nursery stock transported. This copy must be an exact transcript, and must include number, date of issue and of expiration. After the expiration date, the permit becomes invalid and should not be used. The dealer has no right to alter the date or any other portion of the permit. This permit may be revoked for improper use or abuse, and for not complying with the law.

Shipper's Permits

The shipper's permit is issued to nurserymen in other states who file applications and duplicate signed copies of their state inspection certificates. The original permit should be kept, and a copy (typed or printed) together with a copy of the inspection certificate of the state in which the nursery is situated should accompany each shipment into Connecticut.

Package Certificates

Occasionally individuals and firms not in the nursery business wish to ship a few trees or shrubs but cannot do so without inspection certificates. If such materials can be inspected by our men on their usual trips without extra travel and expense, this will be done on request, as an accommodation. Other inspections may be arranged by special appointment, or plants can be sent to the Station with address and postage for forwarding, and here they will be examined and sent along.

The U. S. Postal Laws and Regulations, Section 467, paragraph 2, governs the mailing of plants and plant products, and reads as follows:

"Nursery stock, including all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable and flower seeds, bedding plants and other herbaceous plants, bulbs and roots, may be admitted to the mails only when accompanied with a certificate from a State or Government inspector to the effect that the nursery or premises from which such nursery stock is shipped has been inspected within a year and found free from injurious insects, and plant diseases, and the parcel containing such nursery stock is plainly marked to show the nature of the contents and the name and address of the sender."

Such materials may be mailed without certificate to any Agricultural Experiment Station or to the United States Department of Agriculture. Florists' plants (not woody, field-grown) and vegetable or other annual herbaceous plants do not require certificates but must be plainly marked as to contents, origin and destination. Package certificates apply only to the contents of

the packages on which they are placed, and the contents of which have been examined.

Quarantines

Both state and Federal quarantines prohibit the movement of nursery stock and forest products from the area quarantined on account of gipsy and brown-tail moths to any point outside of that area, without inspection and certificate. Federal Inspectors will be stationed at convenient points to cover the quarantined area of the state. Applications for such inspections may be made to the nearest Federal Inspector or to the following:

Mr. D. M. Rogers, 408 Atlantic Avenue, Boston, Mass.
In charge of Federal gipsy moth quarantine inspection service.
Dr. W. E. Britton, State Entomologist, Agr. Exp. Sta., New Haven, Conn.
In charge of state gipsy moth quarantine inspection service.

Circular letters were issued to nurserymen and dealers, and notices published in Connecticut newspapers calling attention to the new law and its provisions. The law provides that all nursery certificates shall expire on August 1 of each year. All dealer's permits have been made to expire on December 31, and all shipper's permits are valid during the period covered by the certificates issued to the nurseries by their respective States.

Inspection Work

The annual inspection of growing nursery stock was begun July 7, and most of it was completed by October 15, though a few applied afterward and these inspections were made later. This work was in charge of Mr. M. P. Zappe, who was assisted by Messrs. J. L. Rogers, and G. T. Thompson, and Dr. W. R. Hunt of the Botany Department. Mr. B. H. Walden inspected two nurseries and W. E. Britton, one; Messrs. R. B. Friend and R. C. Botsford, each helped one or two days, and Mr. E. M. Stoddard of the Botany Department helped inspect two nurseries. In one large forest plantation from which trees were sold, Messrs. W. O. Filley, H. W. Hicock, J. E. Riley, Jr., R. Gregory Belcher and Thomas H. Vance of the Forestry Department, assisted.

In addition to the inspections made by the nursery inspectors, the gipsy moth scouts were instructed to make careful examinations for gipsy moth eggs in and around all nurseries in the quarantined area, and to report promptly to the office in case any were found. No gipsy moth infestations were discovered in or near any Connecticut nursery in 1925.

In 34 nurseries no important pests were found. A list of insect pests and plant diseases found in nurseries during the annual inspection of 1925, together with the number of nurseries infested by each, is given below:

LIST OF PESTS FOUND IN NURSERIES IN 1925

Nurseries uninfested 34

INSECTS

Aphids, apple, green	10	Mite, European red	3
woolly	11	pear blister	9
cherry	1	on silver maple	1
on larch	1	spruce	6
spruce gall,		Red-humped caterpillar	2
Chermes abietis	27	Sawfly, *Diprion simile*	1
" *cooleyi*	19	pine	1
on willows	1	Scale, elm	8
Apple and thorn skeletonizer	8	oak gall scale (*Kermes*)	2
Birch bucculatrix	1	pitmaking	1
Borer, bronze birch	1	oyster-shell	38
lilac	4	pine-leaf	4
poplar	1	rose	3
willow	2	San José	32
Cherry and pear slug	1	scurfy	1
Curculio, poplar and willow	1	tulip tree	6
Elm leaf beetle	5	white elm	1
European pine shoot moth	1	Tarnished plant bug	2
Fall webworm	6	Tent caterpillar	1
Lace bugs on Crataegus	1	White grubs	1
rhododendron	6	White pine weevil	5
Laspeyresia molesta	11	Willow leaf beetle, Imported	
Leafhoppers on apple	18	*Plagiodera versicolora*	6
lilac	1	*Lina scripta*	1
Mite, box	1	Yellow-necked caterpillar	1

PLANT DISEASES

Apple scab	30	Mildew on horsechestnut	2
Black knot	1	lilac	7
Brown rot	1	rose	33
Canker, poplar	34	spiraea	1
Crown gall	3	Peach yellows	1
Fire blight	3	Raspberry anthracnose	1
Leaf spot on catalpa	3	mosaic	6
pear	1	Rust on hawthorn	1
quince	2	white pine blister on *Ribes*	7
rose	6	cedar (on apple)	35
Mildew on apple	7	(on cedar)	1
catalpa	15	sweet fern (on pine)	1
cherry	1	on willows	1
grapes	16		

From an examination of the preceding list it will be seen that the oyster-shell scale still continues to be the commonest pest found in Connecticut nurseries, occurring in 38 of them. The next most common pests in order of their abundance are as follows: cedar rust on apple, 35 nurseries; poplar canker, 34 nurseries; mildew on rose, 33 nurseries; San José scale, 32 nurseries; apple scab, 30 nurseries; spruce gall aphid, *Chermes abietis*, 27 nurseries, and *Chermes cooleyi*, 19 nurseries.

In order to show how the figures of 1925 correspond with those of preceding years, the following table gives the data for the past eight years, as reported by the inspectors:

EIGHT YEAR RECORD OF SERIOUS AND COMMON NURSERY PESTS

Pest	1918	1919	1920	1921	1922	1923	1924	1925
Oyster-shell scale	39	38	38	36	44	42	44	38
San José scale	18	19	11	28	19	20	32	32
Spruce gall aphids	15	19	21	31	21	28	40	27
White pine weevil	5	5	1	1	19	17	5	5
Apple and thorn skeletonizer	..	..	..	..	1	18	2	8
Poplar canker	6	5	13	21	31	34	25	34
Pine blister rust (on *Ribes*)	1	..	..	2	9	6	8	7
Nurseries uninfested	32	32	46	36	36	32	33	34

It may be seen from the table that in 1925, the two species of spruce gall aphids together form the commonest pest in Connecticut nurseries, and must be given some treatment to hold them in check. The oyster-shell scale, however, is and has been for the past eight years the commonest single species pest, though the past season the pine blister rust (on *Ribes*), the poplar canker and the San José scale are not far behind. It is hoped that we can soon issue a bulletin on insect pests of the nursery, giving directions for control, so that the Connecticut nurserymen will know just what treatments will hold these pests in check.

NUMBER OF NURSERIES

The operation of the new law requiring nurserymen to register has brought to light many new nurseries, that heretofore were unknown to the State Entomologist. During the season of 1925, 160 nurseries have been inspected. Of this number 153 have received regular certificates; two of these were inspected twice, once in the spring and again in the fall; three have informed this office since the inspection that they have discontinued the business. Three have been instructed regarding slight infestations, but have not notified this office that the directions have been carried out.

In addition to these inspections and certificates, 118 separate parcels of nursery stock have been inspected and package certificates furnished; also 143 duplicate certificates have been furnished the regular nurserymen for filing in other States.

The total area of Connecticut nurseries in 1925 is about 2,731 acres, and the list contains 151 names, as follows:

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1925

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Amelunxen & De Wyn	Yalesville	2	Aug. 5	12
Baby Blue Spruce Gardens	New Milford	1	Sept. 5	66
Barnes Bros. Nursery Co.	Yalesville and Durham	150	Aug. 17	22

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Barnes Nursery & Orchard Co.	Wallingford	50	Oct. 20	129
Barton Nursery	Hamden	1	Sept. 4	60
Benbow, A.	Norfolk	1	Sept. 14	85
Berkshire Nurseries (C. B. Myers, Mgr.)	Milford	10	Dec. 12	150
Bernson, Gosta M.	Cromwell	1	Aug. 5	16
Bertolf Brothers	Greenwich	45	Aug. 21	31
Booy, H. W.	Yalesville	2	Aug. 6	17
Brainard Nursery & Seed Co.	Thompsonville	10	Aug. 26	40
Braley & Co.	Burnside	2	Aug. 24	37
Branford Nurseries (2)	Branford	4	Sept. 5	64
Bretschneider, A.	Danielson	1	Sept. 16	88
Bridgeport Hydraulic Co.	Bridgeport	650	Sept. 28	105
Bristol Nurseries, Inc.	Bristol	20	Sept. 16	87
Brooklawn Conservatories	Bridgeport	1	Sept. 2	55
Brouwer's Nurseries	New London	2	Aug. 20	29
Brown, E. M.	Hartford	2	Oct. 13	122
Burr & Co., C. R.	Manchester	500	July 23	1
Burroughs, Thos. E.	Deep River	4	Sept. 1	46
Cant, Alexander	Springdale	1	Nov. 7	141
Cardarelli, E. J.	Cromwell	2	Aug. 3	10
Chapman, C. B.	Groton	1	Oct. 10	118
Chapman, C. E.	No. Stonington	2	Sept. 2	52
Clinton Nurseries (Warren Richards, Mgr.)	Clinton	2	Sept. 17	91
Conine Nursery Co.	Stratford	50	Aug. 19	26
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	1	Aug. 21	32
Conn. Agr. Expt. Station (W. O. Filley, Forester)	New Haven	1	Sept. 30	107
Corrigan, James J.	West Haven	1	Sept. 22	101
Courtland Avenue Nurseries (A. Pedersen, Prop.)	Stamford	1	Sept. 10	76
Cross Highway Nurseries	Westport	6	Dec. 10	147
Curtis, E. D.	Bantam	3	Dec. 18	151
Dallas, Inc., Alexander	Waterbury	5	Sept. 21	97
Dawson's Nursery	Willimantic	1	Sept. 14	84
Dowd, Inc., F. C.	Madison	2	Nov. 10	143
Dunlap, Daniel S.	Cromwell	3	Aug. 3	8
Eager, Edward M.	Bridgeport	1	Dec. 5	145
East Rock Nursery (S. Palmieri, Prop.)	New Haven	1	Sept. 12	80
Edgewood Nursery	New Haven	1	Oct. 23	135
Edgewood Nursery, Vidal, Mackintosh, Inc.	Stamford	1	Oct. 10	120
Eells & Sons	Manchester	1	Aug. 13	19
Eldredge, C. F.	Niantic	1	Nov. 18	144
Elm City Nursery Co., Woodmont Nurseries, Inc.	New Haven and Woodmont	100	Aug. 31	42
Elm Grove Cemetery Association	Mystic	1	Oct. 23	132
Engelhardt, Paul	Wallingford	1	Sept. 22	100
Ensign-Bickford Co.	Simsbury	10	Dec. 10	148
Evergreen Nursery Co.	Wilton	12	Aug. 21	30
Fraser's Nurseries	Willimantic	2	Sept. 1	48
Galligan, C. W.	North Haven (Address West Haven)	1	Oct. 14	124

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Gardner's Nurseries	Rocky Hill	22	July 28	4
Geduldig's Greenhouses	Norwich and Ledyard	2	Sept. 10	74
Geremia, Frank	Yalesville	1	Oct. 23	133
Geremia, Joseph	Yalesville	1	Aug. 5	11
Glen Terrace Nursery (J. H. Everett, Prop.)	Mount Carmel	14	Nov. 10	142
Golden Hill Nursery (A. Johnson, Prop.)	Shelton	1	Oct. 2	111
Hanford, R. G.	Norwalk	1	Oct. 2	112
Hansen, Peter	Fairfield	2	Sept. 3	57
Heath & Co.	Manchester	5	July 23	2
Hilliard, H. J.	Sound View	1	July 28	5
Hiti Nurseries (J. H. Bowditch, Prop.)	Pomfret Center	8	Aug. 22	36
Holcomb, Irving	Simsbury	1	Aug. 7	18
Holdridge, S. E.	Ledyard (Address Norwich)	2	Sept. 2	53
Hoogendoorn, C.	Yalesville	1	Aug. 5	14
Horan & Son, Jas.	Bridgeport	2	Sept. 19	95
Houston's Nurseries	Mansfield	10	Oct. 20	130
Hoyt's Sons Co., Inc., The Stephen	New Canaan	400	Aug. 31	43
Hubbard, C. S.	Cromwell	1	Aug. 31	41
Hull, Curtis M.	Wallingford	1	Oct. 23	134
Hunt & Co., W. W.	Hartford	10	Aug. 31	44
Intravaia, Joseph	Middletown	1	Sept. 21	98
Jennings, G. S.	Southport	1	Nov. 3	138
Jones, William	Norwalk	1	Oct. 15	126
Kelley, James J.	New Canaan and Darien	9	Sept. 12	83
Kerner, Eugene	Woodbury	7	Sept. 22	103
Keso Nursery (J. J. Kelsey, Prop.)	Clinton	1	Sept. 4	63
Keystone Nurseries (H. H. Kellner, Prop.)	Danbury	1	Sept. 10	75
Leghorn, John J.	Cromwell	2	Aug. 3	9
Long Hill Nursery (John Eckner, Prop.)	Burnside	1	Oct. 7	115
Malavasi & Son, Sam	New Haven	1	Oct. 19	128
Mallett Co., Geo. A.	Bridgeport	1	Sept. 17	90
Maplewood Nurseries (T. H. Peabody, Prop.)	Norwich	1	Oct. 15	125
Marigold Farm (H. Kelley, Prop.)	New Canaan	5	Oct. 2	108
Marshall, Robert	Wethersfield	1	Oct. 2	110
Meier, A. R.	West Hartford	1	Aug. 22	34
Merwin Lane Nursery	Fairfield	2	Sept. 10	77
Middeleer, Charles	Darien	10	Sept. 19	96
Millane Tree Expert Co.	Middletown	1	Sept. 9	73
Morgan, Wm. F.	No. Stonington (Address Westerly, R. I.)	3	Oct. 13	123
New Haven Nurseries (L. A. Soldan, Prop.)	New Haven	1	Oct. 7	114
New Haven Park Commissioners (G. X. Amrhyn, Supt.)	New Haven	16	Sept. 9	71
Newington Gardens	Newington	2	Aug. 22	35

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
New London Cemetery Assn. (E. E. Rogers, Pres.)	New London	1	Aug. 20	27
New London County Nurseries (W. J. Schoonman, Prop.)	New London	4	Sept. 5	69
New London Greenhouses and Nursery, Inc. (Geo. A. Gorton, Receiver)	New London	1	Oct. 21	131
Nicolson & Thurston	Litchfield	1	Sept. 6	67
North-Eastern Forestry Co. .	Cheshire	40	July 31	7
Norwich Nursery (O. E. Ryther, Prop.)	Norwich	6	Oct. 29	137
Norwood Nursery	Hamden	1	Oct. 3	113
Nott Plant Co.	Meriden	1	Oct. 8	116
Oakland Nurseries	Manchester	5	July 23	3
Outpost Nurseries (L. D. Conley, Prop.)	Ridgefield	50	Sept. 18	93
Ouwerkerk & Van der Stam	Yalesville	15	Aug. 5	13
Park Gardens	Bridgeport	1	Nov. 5	140
Pequod Nursery Co.	Yalesville	15	July 31	6
Perry, Wilfred S.	Waterbury	1	Oct. 2	109
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Sept. 30	106
Pierson, Inc., A. N.	Cromwell	60	Aug. 17	23
Plumley, D. L.	Clintonville	1	Sept. 4	61
Polish Orphanage Farm	New Britain	1	Sept. 11	78
Pomeroy, Edwin C.	Northville	1	Sept. 5	65
Reumann, Theodore	Stamford	1	Oct. 10	119
Ridgefield Florist & Nursery Co. (W. Pinchbeck, Prop.) (2)	Ridgefield	2	Sept. 16	89
Rockfall Nursery Co. (P. Marotta, Prop.)	Rockfall	50	Aug. 13	21
Rowayton Greenhouses, Inc.	Rowayton	1	Sept. 5	70
Rushworth, Edwin	Yalesville	1	Aug. 5	15
Russell, C. B.	Newington	1	Oct. 9	117
Saxe & Floto	Waterbury	1	Oct. 23	136
Schaeffer Bros. Nursery	Ledyard	3	Aug. 17	24
Scheepers, Inc., John	Stamford	14	Sept. 2	56
Scott's Nurseries	Hartford	5	Dec. 8	146
Sierman, C. H.	Hartford	8	Aug. 26	38
Southport Nursery (L. Coari, Prop.)	Southport	10	Aug. 21	33
South Wilton Nurseries	South Wilton	3	Sept. 1	47
State Forest Nursery (A. F. Hawes, State Forester) ..	Weatogue	2	Sept. 12	82
State Street Nursery	New Haven	2	Sept. 1	50
Steck, Chas. A.	Newtown	6	Oct. 13	121
Steck, Harold W.	Farmington	1	Sept. 22	99
Steck, Mrs. Sarah B.	Bethel	1	Sept. 28	104
Stratfield Nurseries	Bridgeport	15	Nov. 3	139
Stratford Florist Co. (C. A. Cooper, Prop.)	Stratford	1	Sept. 12	81
Stratford Rose Nurseries (John Barrow, Prop.) ...	Stratford	1	Sept. 3	58
Sunny Ridge Nursery (C. A. Steck, Jr., Prop.)	Bethel	6	Sept. 22	102

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Szirbik & Co., Geo.	New Haven	1	Oct. 16	127
Tanner's Nursery Co.	Manchester	4	Aug. 26	39
Thomas, D. W.	Highwood	1	Sept. 14	86
Tow Path Gardens (S. W. Eddy, Prop.)	Avon	1	Dec. 10	149
Upson, R. E.	Marion	2	Sept. 17	92
Vanderbrook & Son, Chas. L.	Manchester	11	Aug. 13	20
Van Wilgen Nurseries	Branford	7	Sept. 2	54
Vasileff, Nicholas	Greenwich	1	Sept. 4	62
Verkade's Nurseries	New London, Lyme and Chesterfield	20	Aug. 20	28
Wallace Nursery	Wallingford	5	Sept. 4	59
Wayside Farm Gardens	Thomaston	1	Sept. 5	68
Wheeler, Chas. B.	No. Stonington	2	Sept. 2	51
Wilcox, Harry D.	Avon	1	Sept. 11	79
Wild, Henry	Greenwich and Norwalk	20	Sept. 1	45
Wilson & Co., C. E.	Manchester	75	Aug. 19	25
Woodruff, C. V.	Orange	1	Sept. 18	94
Yale University, School of Forestry	New Haven	2	Sept. 1	49
Zack Co., H. J.	Deep River	5	Sept. 9	72

Total, 151 nurseries .....2,731 acres

Inspection of Raspberry Plantations

A number of raspberry growers and nurserymen applied for inspections in order to obtain certificates for plants free from mosaic. Consequently two inspections of each were made by Entomologists and Botanists of 11 plantations, mostly in nurseries. Some of these plantations contained too much mosaic to grant certificates, but six special certificates were granted, as follows:

Special Certificates on Raspberry Plants

Name of Firm	Address	Variety	Certificate Issued	No. of Certificate
Barnes Nursery & Orchard Co.	Wallingford	Herbert St. Regis	Sept. 28	7
Burr & Co., C. R.	Manchester.	Marlboro St. Regis	Sept. 30	11
Conine Nursery Co., F. E.	Stratford	Cuthbert Kansas St. Regis	Sept. 28	8
Long Hill Nursery (John Eckner, Prop.)	Burnside	St. Regis	Sept. 28	10
Rockfall Nursery Co.	Rockfall	Columbian Cuthbert Kansas Plum Farmer St. Regis	Sept. 28	6
Scheepers, Inc., John	Stamford	LaFrance	Sept. 28	9

Nursery Dealers

As provided by the new law, dealers in nursery stock must also register, and notices and application blanks were sent out to all addresses of dealers that could be obtained, and notices were published in the newspapers, calling attention to the provisions of the new law. As a result, 57 dealers' permits were issued for the six months from July 1, when the new law went into effect, until

OFFICE OF STATE ENTOMOLOGIST

STATE OF CONNECTICUT

NEW HAVEN CONN.

No._____ _____ 192

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

DEALER'S PERMIT

This is to Certify that_____ of

_____ has registered as a dealer in nursery stock as provided in Chapter 265, Public Acts of 1925, and is therefore authorized to buy, sell, and transport stock within the State.

Not valid after_____ 192____

_____

State Entomologist

Fig. 39.—Facsimile of dealer's permit, less than two-thirds size.

December 31. These permits were issued only for the remainder of the current year. The list of dealers is not included in this Report, though a facsimile of the permit is shown in Figure 39.

Out-of-State Shippers

Following the provisions of the new law, nurserymen in other states wishing to ship nursery stock into Connecticut are required to file copies of their inspection certificates with the State Entomologist, and receive permits allowing them to ship stock into the State. Application blanks were sent to all nurserymen who filed certificates and to others whom we thought might wish to fill Connecticut orders. The requirements of the new law have also been published in the nursery journals. The permit issued to each

firm covered the same period as the inspection certificate filed by that firm. For the six months from July 1, when the new law became operative, until December 31, 107 such permits have been

OFFICE OF STATE ENTOMOLOGIST

STATE OF CONNECTICUT

NEW HAVEN CONN.

No._____ _____ 192

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

SHIPPER'S PERMIT

This is to Certify that _____

of _____, _____ has complied with the requirements of Chapter 265, Public Acts of 1925, and is therefore permitted to ship nursery stock into the State of Connecticut.

Not valid after _____ 192____.

_____

State Entomologist

FIG. 40.—Facsimile of shipper's permit, less than two-thirds size.

issued. They are called "shipper's permits" and a facsimile is shown in Figure 40. The list of nurserymen receiving them is not published in this Report.

INSPECTION OF IMPORTED NURSERY STOCK

The nursery stock entering Connecticut from foreign countries during 1925 has been fruit and rose seedlings for propagation. This stock has been inspected as in preceding years mostly by Mr. Zappe, though assisted at certain times by Messrs. Walden and Rogers. The number of shipments, cases and plants was less than in 1924, as shown in the table below which gives the statistics for the past six years:

Year	No. of Shipments	No. of Cases	No. of Plants
1920	17	87	814,491
1921	21	126	1,228,560
1922	30	159	1,997,595
1923	35	179	1,981,895
1924	33	313	3,489,170
1925	27	277	2,977,346

These 27 shipments were imported by eight different Connecticut firms, 18 of them being consigned to two firms. Of the total number, 16 shipments contained rose stocks and 10 shipments contained fruit stocks. One shipment contained both fruit and rose stocks.

The time required to inspect this stock is equivalent to one man working 40 days and this time, together with the cost of travel and other necessary expenses, amounts to about $500.00.

Of this material, 1,233,334 plants were rose stocks and 1,754,012 were fruit stocks, the number of each variety being shown in the following table:

FRUIT STOCK

Variety	No. Plants	Total
Apple	755,512	
Apple, dwarf (Doucin)	6,000	
Cherry	545,000	
Pear	195,000	
Plum	191,000	
Quince	61,500	1,754,012

ROSE STOCK

Rosa manetti	1,109,750	
Rosa rugosa	113,584	1,223,334
		2,977,346

Though the greatest number of shipments came from Holland, the greatest number of cases and plants came from France as the following table will show:

SOURCES OF IMPORTED NURSERY STOCK, 1924-1925

Country	No. Shipments	No. Cases	No. Plants
France	10	167	1,904,000
Holland	14	105	999,584
England	2	4	73,750
Canada	1	1	12
	27	277	2,977,346

The following table shows the quantities of stock as inspected by months:

Month	No. Shipments	No. Cases	No. Plants
November	1	2	15,000
December	2	21	217,500
January	8	32	307,734
February	3	34	365,600
March	2	18	180,000
April	8	152	1,701,500
May	3	18	190,012
	27	277	2,977,346

In addition to the material tabulated above, there were 19 shipments containing 25 packages of seeds, mostly of trees and palms, which were not inspected in Connecticut.

Of the 27 shipments inspected, 18 shipments or 66 per cent, were found infested with insects or plant diseases. One of them, *Aporia crataegi* Linn., on apple and pear stock from France, is considered a dangerous insect pest, which should be kept out of the United States if possible. Details regarding the pests discovered in these shipments are given below:

PESTS FOUND ON IMPORTED NURSERY STOCK

18 Shipments Infested.

Insects

Acronycta rumicis Linn., on cherry stock. (1 shipment.) Andre Choplin, Angers, France.

Aporia crataegi Linn., on apple stock. (3 shipments.) Franco-American Seedling Co., Angers, France; Andre Choplin, Maze, France (on pear and apple stock).

Calophasia lunula Hubner, on pear stock. (1 shipment.) Andre Choplin, Maze, France.

Emphytus cinctus Linn., on rose stock. (13 shipments.) Fa. As. Ouwerkerk, Boskoop, Holland; Walter C. Slocock, Woking, England; M. Gielen, Oudenbosch, Holland; Oudyk Bros., Boskoop, Holland; H. H. Woldering, Veendam, Holland; B. Ruys, Ltd., Dedensvaart, Holland; Andre Choplin, Angers, France.

Gelechiidae sp. on cherry. Andre Choplin, Angers, France.

Lepidopterous cocoon, on apple. Andre Choplin, Maze, France.

Leptocryptus lacustris Sch., on quince. Andre Choplin, Angers, France.

Notolophus antiqua Linn., egg mass on apple leaf. (1 shipment.) Franco-American Seedling Co., Angers, France.

Plant Diseases

Crown Gall on rose stocks. (2 shipments.) M. Gielen, Oudenbosch, Holland; Andre Choplin, Angers, France.

INSPECTION OF APIARIES IN 1925

In 1925, as for several years past, the apiary inspection work has been done by Messrs. H. W. Coley of Westport and A. W. Yates of Hartford, on a *per diem* basis. Mr. Coley covers the southern half of the State (Fairfield, New Haven, Middlesex and New London Counties), and Mr. Yates the northern half (Litchfield, Hartford, Tolland and Windham Counties).

This work required a total of 130 man days and the entire cost for the season was $1,881.45.

Fewer apiaries were inspected in 1925 than in 1924, though the apiaries averaged slightly larger than last year. The following table shows the number of apiaries and colonies inspected and the average number of colonies per apiary for each year in Connecticut, since the inspection work was commenced in 1910.

SIXTEEN YEAR RECORD OF APIARY INSPECTION IN CONNECTICUT

Year	No. of Apiaries	No. of Colonies	Average No. Colonies Per Apiary	Average Cost of Inspection Per Apiary	Per Colony
1910	208	1,595	7.6	$2.40	.28
1911	162	1,571	9.7	1.99	.21
1912	153	1,431	9.3	1.96	.21
1913	189	1,500	7.9	1.63	.21
1914	463	3,882	8.38	1.62	.19
1915	494	4,241	8.58	1.51	.175
1916	467	3,898	8.34	1.61	.19
1917	473	4,506	9.52	1.58	.166
1918	395	3,047	7.8	1.97	.25
1919	723	6,070	11.2	2.45	.29
1920	762	4,797	6.5	2.565	.41
1921	751	6,972	9.2	2.638	.24
1922	797	8,007	10.04	2.60	.257
1923	725	6,802	9.38	2.55	.27
1924	953	8,929	9.4	2.42	.25
1925	766	8,257	10.7	2.45	.22

In 1925, apiaries were inspected in 118 towns against 142 in 1924 and 119 towns in 1923.

Inspections were made in the following 16 towns in 1925 which were not visited in 1924: Fairfield County: Bethel; Middlesex County: Saybrook; New London County: Lyme; Litchfield County: Harwinton and New Hartford; Hartford County: Bloomfield, East Granby, East Windsor, Granby, Hartford, Marlborough, Suffield, Windsor and Windsor Locks; Tolland County: Hebron; Windham County: Scotland.

On the other hand, the following 41 towns where inspections were made in 1924, were not visited by the inspectors in 1925: Fairfield County: Brookfield, Fairfield, Monroe, Newtown, Stratford, Trumbull, and Weston; New Haven County: Branford, East Haven, Hamden, Milford, New Haven, North Branford, Orange, West Haven, Wolcott and Woodbridge; Middlesex County: Middlefield; New London County: Ledyard, New London, and North Stonington; Litchfield County: Bridgewater, New Milford, Roxbury, Washington, Woodbury; Hartford County: Enfield, New Britain, Plainville, and Southington; Tolland County: Andover, Ellington, Somers, Stafford, Tolland, Union, Vernon, and Willington; Windham County: Ashford, Eastford, and Pomfret.

European Foul Brood

European foul brood is a bacterial disease of the young larvae caused by *Bacillus pluton*. It is more destructive in spring and early summer than at other periods of the year. The cell contents are usually not gelatinous or ropy, and though the odor of fermentation is generally present, it is not very offensive. The remedy is to requeen the diseased colonies with Italian queens,

and to build up strong colonies by uniting two or more weak colonies if deemed necessary.

Of the 766 apiaries and 8,257 colonies inspected in 1925, 19 apiaries and 42 colonies were found infested with European foul brood. This is 2.48 per cent. of the apiaries and .507 per cent. of the whole number of colonies inspected during the season. This is a somewhat larger percentage of the apiaries and slightly smaller percentage of the colonies than were found infested by this disease in 1924. The following table shows the figures regarding European foul brood since the inspection began in 1910.

RECORD OF EUROPEAN FOUL BROOD

Year	Percentage of Infestation		Year	Percentage of Infestation	
	Apiaries	Colonies		Apiaries	Colonies
1910	75.9	49.7	1918	9.8	3.3
1911	51.8	27.4	1919	6.6	1.2
1912	47.7	23.5	1920	4.3	1.5
1913	44.4	24.5	1921	3.91	1.26
1914	32.6	13.9	1922	4.14	.85
1915	26.1	10.3	1923	2.34	.36
1916	18.8	7.05	1924	1.78	.526
1917	16.7	4.86	1925	2.48	.507

During 1925, European foul brood was found only in Naugatuck, New Haven County; Lebanon, New London County; Cornwall, Watertown, and Winchester, Litchfield County; Canton, Granby, Marlborough, and Suffield, Hartford County; Hebron, Tolland County; Plainfield, Putnam, and Sterling, Windham County. None was found in Fairfield and Middlesex Counties.

American Foul Brood

American foul brood is also a bacterial disease of the larvae, caused by *Bacillus larvae,* but it attacks at a later stage of the brood development than does the European foul brood. It usually shows when the larvae are mature and pupating after the cells are sealed. The diseased cells become sunken, and if broken open, the contents have a peculiar ropy or stringy consistency and a very offensive odor. The remedy has been to shake into clean hives, destroy the infected combs, and disinfect the old hives. Now it is feasible to sterilize the combs by soaking them in an alcohol-formalin solution containing 20 per cent. formalin, after which they can safely be used.

Of the 766 apiaries and 8,257 colonies inspected in 1925, 26 apiaries and 38 colonies were found diseased with American foul brood. This is 3.26 per cent. of the apiaries and .446 per cent. of the whole number of colonies inspected in 1925. This is a somewhat larger percentage of infestation than has been found for several years, as the following table will show:

RECORD OF AMERICAN FOUL BROOD

Year	Percentage of Infestation Apiaries	Colonies	Year	Percentage of Infestation Apiaries	Colonies
1910	0	0	1918	1.01	.32
1911	0	0	1919	3.	1.1
1912	0	0	1920	1.18	.25
1913	0	0	1921	2.5	.56
1914	1.07	.7	1922	1.38	.27
1915	.8	.18	1923	.965	.323
1916	1.07	.15	1924	1.04	.22
1917	.42	.17	1925	3.26	.424

During 1925, American foul brood was found in Ridgefield, Stamford and Wilton, Fairfield County: Meriden, Wallingford, and Waterbury, New Haven County; Cromwell and East Haddam, Middlesex County; Norwich, New London County; Litchfield, Plymouth, and Torrington, Litchfield County; Andover, Tolland County; and Bristol and Manchester, Hartford County. None was found in Windham County.

Sacbrood

Sacbrood or pickled brood is a disease caused by a filterable virus, and is often mistaken for European or American foul brood. The larvae die about the time the cells are capped and lie on their backs with heads turned upward. The color, though variable, is often light yellow or brown with head nearly black. The body is swollen and the contents are watery, but there is no ropiness. The entire cell contents can readily be removed intact as if enclosed in a sac.

Treatment for sacbrood consists in keeping bees from contact with infected honey, frames and hives, and in uniting weak colonies to make strong ones.

In 1925, sacbrood was found in 26 apiaries and 69 colonies. This is 3.39 per cent. of the apiaries, and .83 per cent. of the colonies examined.

RECORD OF SACBROOD

Year	Percentage of Infestation Apiaries	Colonies	Year	Percentage of Infestation Apiaries	Colonies
1910	0	0	1918	.253	.032
1911	..	.51	1919	1.24	.19
1912	..	Several	1920	1.18	.229
1913	..	2.8	1921	1.06	.157
1914	2.59	.721	1922	1.37	.187
1915	2.02	.47	1923	.53	.086
1916	.428	.051	1924	1.78	.52
1917	1.48	.199	1925	3.39	.836

Paralysis

Adult bees are sometimes sickly, and are said to have paralysis. The cause may be poisoning or several other conditions, and it is

usually impossible to give advice regarding treatment, particularly until more is known about symptoms and conditions concerning the apiary.

Statistics of Inspection

The statistics of apiary inspection by towns and counties may be found on the following pages, with summary on page 253.

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Foul Brood Sacbrood	Foul Brood Paralysis
Fairfield County:								
Bethel	4	0	32	0	0	0	0	0
Danbury	2	1	44	8	0	0	8	0
Darien	7	1	46	1	0	0	0	1
Easton	4	0	91	0	0	0	0	0
Greenwich	28	3	206	7	0	0	7	0
New Canaan	12	1	103	6	0	0	6	0
Norwalk	6	0	53	0	0	0	0	0
Redding	2	0	8	0	0	0	0	0
Ridgefield	4	1	16	1	1	0	0	0
Shelton	1	0	28	0	0	0	0	0
Stamford	35	4	333	8	5	0	3	0
Westport	1	0	7	0	0	0	0	0
Wilton	6	1	123	1	1	0	0	0
	112	13	1,090	32	7	0	24	1
New Haven County:								
Beacon Falls	2	0	27	0	0	0	0	0
Cheshire	7	0	81	0	0	0	0	0
Derby	3	1	22	1	0	0	1	0
Guilford	2	0	28	0	0	0	0	0
Madison	2	1	26	1	1	0	0	0
Meriden	24	0	195	0	0	0	0	0
Naugatuck	2	2	31	6	0	3	3	0
North Haven	5	0	45	0	0	0	0	0
Prospect	2	0	16	0	0	0	0	0
Seymour	2	1	36	1	0	0	1	0
Wallingford	26	6	174	14	4	0	10	0
Waterbury	2	1	89	3	3	0	0	0
	79	12	770	26	8	3	15	0
Middlesex County:								
Chester	8	1	80	2	0	0	2	0
Clinton	5	4	62	19	3	0	16	0
Cromwell	2	0	66	0	0	0	0	0
Durham	8	2	98	3	2	0	0	1
East Haddam	7	0	120	0	0	0	0	0
East Hampton	14	0	166	0	0	0	0	0
Essex	4	1	72	2	0	0	2	0
Haddam	4	0	68	0	0	0	0	0
Killingworth	1	1	9	3	0	0	3	0

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Foul Brood Sacbrood	Foul Brood Paralysis
Middlesex County—*cont.*:								
Middletown ...	5	1	27	1	0	0	0	1
Old Saybrook..	8	1	72	2	0	0	2	0
Portland	5	0	38	0	0	0	0	0
Saybrook	2	0	9	0	0	0	0	0
Westbrook	1	1	4	1	0	0	1	0
	71	12	891	33	5	0	26	2
New London County:								
Bozrah	4	0	142	0	0	0	0	0
Colchester	11	0	78	0	0	0	0	0
East Lyme	3	0	59	0	0	0	0	0
Franklin	2	0	104	0	0	0	0	0
Griswold	5	0	130	0	0	0	0	0
Groton	6	1	61	1	0	0	1	0
Lebanon	7	1	140	1	0	3	0	0
Lisbon	2	0	32	0	0	0	0	0
Lyme	2	0	96	0	0	0	0	0
Montville	5	0	53	0	0	0	0	0
Norwich	9	2	440	5	4	0	1	0
Old Lyme	2	0	52	0	0	0	0	0
Preston	3	0	38	0	0	0	0	0
Salem	2	0	44	0	0	0	0	0
Sprague	1	0	16	0	0	0	0	0
Stonington	7	0	83	0	0	0	0	0
Voluntown	2	0	25	0	0	0	0	0
Waterford	2	1	45	1	0	0	1	0
	75	5	1,638	8	4	3	3	0
Litchfield County:								
Barkhamsted ..	6	1	37	2	0	2	0	0
Bethlehem	6	1	22	3	0	3	0	0
Canaan	1	0	7	0	0	0	0	0
Colebrook	5	0	34	0	0	0	0	0
Cornwall	9	1	70	1	0	1	0	0
Goshen	7	0	81	0	0	0	0	0
Harwinton	7	0	40	0	0	0	0	0
Litchfield	12	1	214	2	2	0	0	0
Morris	4	0	39	0	0	0	0	0
New Hartford.	13	0	76	0	0	0	0	0
Norfolk	4	0	25	0	0	0	0	0
North Canaan .	4	0	80	0	0	0	0	0
Plymouth	3	1	21	1	1	0	0	0
Salisbury	6	0	43	0	0	0	0	0
Sharon	3	0	102	0	0	0	0	0
Thomaston	7	0	35	0	0	0	0	0
Torrington	16	1	95	1	1	0	0	0
Watertown	13	1	78	2	0	2	0	0
Winchester ...	15	1	96	2	0	2	0	0
	141	8	1,195	14	4	10	0	0

Town	Apiaries		Colonies		Foul Brood			
	Inspected	Diseased	Inspected	Diseased	American	European	Sacbrood	Paralysis
Hartford County:								
Avon	4	0	32	0	0	0	0	0
Berlin	12	0	183	0	0	0	0	0
Bloomfield	6	0	143	0	0	0	0	0
Bristol	14	1	74	5	4	0	1	0
Burlington	7	0	47	0	0	0	0	0
Canton	16	1	99	5	0	5	0	0
East Granby	6	0	33	0	0	0	0	0
East Hartford	5	0	25	0	0	0	0	0
East Windsor	1	0	19	0	0	0	0	0
Farmington	4	0	18	0	0	0	0	0
Glastonbury	13	0	166	0	0	0	0	0
Granby	3	1	39	2	0	2	0	0
Hartford	3	0	22	0	0	0	0	0
Hartland	1	0	125	0	0	0	0	0
Manchester	14	1	110	3	3	0	0	0
Marlborough	2	1	41	3	0	3	0	0
Newington	1	0	9	0	0	0	0	0
Rocky Hill	4	0	32	0	0	0	0	0
Simsbury	7	0	55	0	0	0	0	0
South Windsor	3	0	33	0	0	0	0	0
Suffield	14	2	102	3	0	3	0	0
West Hartford	20	0	165	0	0	0	0	0
Wethersfield	11	0	62	0	0	0	0	0
Windsor	17	0	80	0	0	0	0	0
Windsor Locks	7	0	27	0	0	0	0	0
	195	7	1,741	21	7	13	1	0
Tolland County:								
Andover	1	1	6	3	3	0	0	0
Columbia	5	0	34	0	0	0	0	0
Coventry	6	0	81	0	0	0	0	0
Hebron	4	1	24	2	0	2	0	0
Mansfield	1	0	8	0	0	0	0	0
	17	2	153	5	3	2	0	0
Windham County:								
Brooklyn	4	0	190	0	0	0	0	0
Canterbury	3	0	33	0	0	0	0	0
Chaplin	3	0	21	0	0	0	0	0
Hampton	9	0	87	0	0	0	0	0
Killingly	7	0	32	0	0	0	0	0
Plainfield	20	3	108	9	0	9	0	0
Putnam	5	1	49	1	0	1	0	0
Scotland	7	0	24	0	0	0	0	0
Sterling	2	1	6	1	0	1	0	0
Thompson	6	0	70	0	0	0	0	0
Windham	7	0	86	0	0	0	0	0
Woodstock	3	0	73	0	0	0	0	0
	76	5	779	11	0	11	0	0

SUMMARY

County	No. Towns	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Foul Brood Sacbrood	Foul Brood Paralysis
Fairfield	13	112	12	1,090	32	7	0	24	1
New Haven ...	12	79	12	770	26	8	3	15	0
Middlesex	14	71	12	891	33	5	0	26	2
New London...	18	75	5	1,638	8	4	3	3	0
Litchfield	19	141	8	1,195	14	4	10	0	0
Hartford	25	195	7	1,741	21	7	13	1	0
Tolland	5	17	2	153	5	3	2	0	0
Windham	12	76	5	779	11	0	11	0	0
	118	766	63	8,257	150	38	42	69	3

	No. Apiaries	No. Colonies
Inspected	766	8,257
Infested with European foul brood	19	42
Per cent. infested	2.48	.507
Infested with American foul brood	26	38
Per cent. infested	3.26	.446
Infested with sacbrood	26	69
Infested with bee paralysis	3	3
Average number of colonies per apiary		10.7
Cost of inspection		$1,881.45
Average cost per apiary		2.45
Average cost per colony		.22

REPORT OF THE GIPSY MOTH WORK

Year Ending June 30, 1925.

By John T. Ashworth and W. E. Britton.

This work has been carried on as in preceding years by State and Federal agencies working in close and friendly co-operation.

The Federal agencies have scouted the towns near and outside the margin of the infested area in order to prevent further spread, and the State appropriation for the most part has been expended within the area known to be infested. This close co-operation has rendered the work far more effective than could possibly result if both agencies worked independently. We hereby express our appreciation and thanks to Mr. A. F. Burgess and his assistant, Mr. H. L. Blaisdell, of the Bureau of Entomology.

In the following pages will be found a brief account of the work done by both State and Federal forces in each town, arranged by counties. Under towns is mentioned only the number of infestations sprayed, but the amount of spraying done in each town may be learned from the table of statistics, pages 267-269, where the quantities of poison used are given (25 pounds of lead arsenate make 400 gallons of spray mixture).

A report on larvae and pupae is also given in the tables; scouting for larvae is done both before and after spraying, around the colonies discovered during the winter. Most of the larvae here reported were found before spraying, and all such larvae and pupae were killed by hand.

New Equipment

Duing the year ending June 30, 1925, considerable new equipment was bought and some of the old renewed: 1,500 feet of new spray hose was purchased from the Acme Rubber Company, and a saving of ten cents per foot effected by using couplings from old or leaky hose. The old Corona typewriter was turned in as part payment for a guaranteed second-hand Remington machine. The old Ford touring car was exchanged toward a new Dodge touring car. The two oldest Ford trucks were also turned in and replaced with new ones; three new Ford trucks were added to the fleet, which now numbers nine Ford delivery trucks and one Dodge and one Buick, both touring cars. A Ford Dealer's cabinet with repair parts, one electric drill, one portable auto jack, and several small tools, such as wrenches, drills, screw drivers and hammers, have been added to the storehouse equipment.

Details of the Work by Towns

The following pages give a detailed account of the conditions in each town where work was done.

WINDHAM COUNTY

Brooklyn—27 Infestations—903 Egg-clusters.

Brooklyn was scouted during September and October by State men. The town was found to be generally, although not heavily, infested. Egg-clusters were found in 57 different places (counting single egg-clusters and colonies). At three of the colonies, 407 or almost half of the total number of egg-clusters were found. Two of these infestations were found on land owned by Mr. Benham, in the southern or Wauregan corner of the town; one colony was found in woodland and a stonewall, the other in an orchard; 268 egg-clusters were found at these two places. One other large colony was found in an orchard owned by Mr. Salmon on Allen Hill. These three and 13 other colonies were sprayed in June by State men.

Killingly—43 Infestations—1,676 Egg-clusters

Killingly was used this year as a school in which to train men in this work for the Federal Bureau, as well as for the State. Most of the infestations found in the town were small for this

territory; there were only three colonies of over 100 egg-clusters each. One of these was found in a stonewall on land owned by Lewis Pringle, situated on the west shore of Old Killingly pond, and contained 290 egg-clusters. Another colony of 120 egg-clusters was found in an apple tree owned by Hiram Franklin, just south of Danielson, on what is known as the Green Hollow road. The last colony to be mentioned was one of 101 egg-clusters, found on a white oak and in a stonewall in Dayville on land owned by Stanley King. Twenty-one colonies were sprayed in May by a State crew.

Plainfield—21 Infestations—428 Egg-clusters

In Plainfield as in Killingly, the scouting was done by men who were being trained, both State and Federal men doing the work. Only two important colonies were found in the town. The largest was a colony of 101 egg-clusters in white oak growth near the north end of Moosup pond, owner unknown. The other was in shade trees and a stonewall on land owned by S. H. Dolly, about one mile east of Plainfield village, where 89 egg-clusters were found, most of them in the stonewall and all but one being old egg-clusters. Twelve of the colonies were sprayed by State men in June.

Pomfret—71 Infestations—2,109 Egg-clusters

Pomfret was scouted early in the year by State crews. As in the last two years, infestations occurred in all parts of the town. About one-fourth of the total number of egg-clusters found were old ones (or hatched). Several infestations were found in stonewalls, but most of them were in woodland; the percentage of orchard infestations was very small in Pomfret this year. There were only three colonies where more than 100 egg-clusters were found; the largest was one of 436 egg-clusters, 191 trees in woodland owned by Mr. Wetherbee in the extreme southwestern corner of the town being infested. The next largest colony was in two white oaks owned by Mr. McGinnes, about one mile east of Pomfret station, where 280 egg-clusters were found. Another colony of 114 egg-clusters was found in woodland and a stonewall on land owned by Howard White, near Pomfret Landing. Twenty-four infestations were sprayed in June by State men.

Putnam —68 Infestations—1,956 Egg-clusters

Scouting in Putnam was completed October 31, and the results showed the town to be infested in about the same degree as last year. There were four colonies of more than 100 egg-clusters each, and four colonies of between 50 and 100 egg-clusters; the

other colonies were mostly small ones. One of the largest colonies was in three oak trees and a stonewall on land owned by Jerome Shippee, near the Putnam Town Farm, containing 189 egg-clusters. Another of 195 egg-clusters was found in an orchard owned by Miss Bertha White, on the State road to Providence, just east of the Windham County Home. One of 127 egg-clusters was found on one white oak in a pasture owned by H. D. Dimond, in the East Putnam district. The fourth colony of 105 egg-clusters was found in a pasture owned by Frank E. C. Pearce; the egg-clusters were in one oak, one hickory and in a stonewall. Forty-two of the infestations were sprayed by State men during May and June.

Scotland

Scotland was scouted by a State crew the last of the season when the foliage was about half grown. This made the work slow and difficult, but the entire town was scouted and no infestations found.

Sterling—2 Infestations—82 Egg-clusters

Federal men who were being trained scouted Sterling this year, and only two colonies of more than five egg-clusters each were found; both were in orchards near the Rhode Island line, just north of the railroad. One orchard was owned by A. Gibson, the other by H. M. Cook, and contained 11 and 16 egg-clusters respectively. Single egg-cluster infestations were scattered through the town, the greater portion being in the northern part. Both colonies were sprayed June 2 by State men.

Thompson—103 Infestations—5,256 Egg-clusters

In Thompson as in several towns in Windham County, the scouting was done by Federal men who were learning to do the work. The town was found infested throughout, and only three of the largest colonies are mentioned. One of 200 egg-clusters was found on roadside oaks near North Grosvenordale; another of 175 egg-clusters was found in one apple tree in a pasture owned by A. J. Barvia, near the railroad just north of West Thompson station. A colony of 153 egg-clusters was found in an orchard and oak woodland owned by John Andrews in North Grosvenordale. By the time the spraying crews reached Thompson, the larvae were nearly full-grown, so only 22 of the infestations were sprayed before the work stopped. Spraying and scouting for larvae was done by State men.

Woodstock—41 Infestations—3,902 Egg-clusters

About two-thirds of Woodstock was scouted by Federal men late in the year; in fact egg-clusters were hatching when the work was stopped. None of the colonies found were considered large for this territory. At the largest colony, 58 egg-clusters were found on one elm tree and in a stonewall, in the southeastern corner of the town. Another of 54 egg-clusters was found in an orchard owned by E. J. Cortiss, in the village of East Woodstock. The next largest colony was one of 26 egg-clusters in an orchard owned by Margaret Potter, on the road leading north from North Woodstock near the Massachusetts line. All the other colonies had less than 25 egg-clusters each, and 15 colonies were sprayed by State men.

NEW LONDON COUNTY

Colchester—5 Infestations—394 Egg-clusters

Colchester was scouted by State men and completed on April 28. Five infestations were found, all of them in the eastern half of the town. Two were large colonies for this territory; the largest contained 325 egg-clusters in woodland owned by Edward Brown, about two miles south of Colchester village. The other colony was about one mile eastward in oak and hickory trees on land owned by Nicholas Clement, where 52 egg-clusters were found. These and two other small infestations of eight egg-clusters each were sprayed by a State crew, about the middle of June.

Franklin—5 Infestations—18 Egg-clusters

Five infestations were found in Franklin by State men, all of them being very small ones. The largest was a colony of nine egg-clusters found in one white oak on land owned by B. Bogacink, about one mile west of Franklin, on the road leading to North Franklin. At each of the other infestations, three egg-clusters or less were found. Two places were sprayed in June by a State crew.

Griswold—3 Infestations—54 Egg-clusters

About two-thirds of Griswold was scouted, the time being insufficient to complete the town. About 37 miles of roadside were covered and three infestations found; one of 51 egg-clusters was in an old apple tree on roadside, in the Pachaug district; another of two egg-clusters was found in two trees (one maple and one elm) on land owned by Ora Askholm, in the extreme northwestern corner of the town; the third of one egg-cluster in an apple tree owned by F. Peterstrom, about one mile south of

Glasko village. Two places were sprayed by State men on June 15.

Groton—2 Infestations —27 Egg-clusters

A training school for the Federal Bureau was started in Groton, continued for several days, and a part of the town scouted and only two infestations found. This region proved to be too sparsely infested for training recruits, and the school was discontinued. One colony of 17 egg-clusters was found in an orchard in Mystic village owned by Charles Benjamin; the other had 10 old egg-clusters in apple and plum trees owned by H. Shaughness near Eastern Point. One colony was sprayed on June 17 by State men.

Lisbon

No scouting was done in Lisbon this year except for larvae. This work was taken up in July after the spraying stopped. As no infestations were found, the men were sent to look over last year's colonies. At one of these, larvae and pupae were found, so every tree around this colony was climbed and thoroughly examined; 285 larvae and pupae were found and destroyed by State men.

Salem

Salem was scouted the last of the season by a State crew and no infestations found.

Stonington—1 Infestation—19 Egg-clusters

The work done in Stonington this year was of the same character as that done in Groton; only one colony and five single egg-cluster infestations were found; then the men were transferred to Thompson. The colony was in white oaks in a pasture owned by Mr. Cash Miller, about one mile south of Stillmanville, and contained 14 egg-clusters. Five single egg-cluster infestations were found scattered in and around the village of Stonington. The colony was sprayed on June 16 by a State crew.

TOLLAND COUNTY

Andover—1 Infestation—30 Egg-clusters

A State crew completed the scouting in Andover on April 20. One colony of 30 egg-clusters was found in one apple tree on land owned by D. Fox, on the south side of the railroad near the Columbia line. This colony was sprayed on June 27 by State men.

Bolton—1 Infestation—26 Egg-clusters

This town was scouted by State men during February and March and one colony of 26 egg-clusters found. This was in woodland owned by Sam Alavoid, about one mile east of Bolton village. Two acres of woodland were sprayed by State men on June 27.

Columbia—2 Infestations—175 Egg-clusters

Two colonies were found in Columbia this year by State men, both in the southwestern part of the town near the Hebron town line on land owned by False Keosenity. One was found in apple trees scattered along the roadside and contained 46 egg-clusters; the other was in woodland where 129 egg-clusters were found. Eighty-eight apple trees and 29 shade trees were sprayed at one colony and one and one-half acres of woodland at the other by State men on June 26.

Ellington—11 Infestations—97 Egg-clusters

Seven of the 11 infestations found in Ellington this year were on or near the State road from Vernon to Somers; none of them were large and only four are mentioned here. The largest infestation contained 28 egg-clusters. This colony was found in apple trees owned by H. Schuldenfrei on the east side of the State road near the Somers town line. Another of 21 egg-clusters was found on a white oak in the margin of woodland owned by Frank Goodiza, about one and one-half miles directly east of the colony just mentioned. One of 17 egg-clusters was found on a white oak owned by Clem Clark, near Ellington depot and another of 14 egg-clusters in a white oak in the northwestern part of the town. Seven of the places were sprayed by State men the latter part of June.

Hebron—1 Infestation—12 Egg-clusters

One colony of 12 egg-clusters was found by State men in Hebron this year, in maple and hickory trees and also a stone-wall along the roadside in the village of Gilead on property owned by H. D. Hodge. This colony was sprayed by State men on June 25.

Somers—16 Infestations—81 Egg-clusters

Somers was scouted by State men, and the work completed on November 15. Sixteen infestations were found scattered in the four corners of the town, with nothing in the center. All the colonies were small and were mostly in apple trees. The largest colony was one of 17 egg-clusters in apple trees owned by Jos.

Pelcozasski, near the Massachusetts line. Another of 15 egg-clusters was found on two oaks owned by M. Keeney, in the village of Somerville. These two colonies were the largest, and most of the others were single egg-cluster infestations. Six of the places were sprayed in June by State men.

Stafford—55 Infestations—1,290 Egg-clusters

Several large colonies were discovered in Stafford this year by State men. The largest contained 225 egg-clusters on a white oak and an apple tree in a field owned by Fred Ramyoni, about one and one-half miles north of Orcuttville. Another of 117 egg-clusters was found in an orchard owned by Charles Stebbens, in the northwestern corner of the town. A colony of 93 egg-clusters was found in apple and oak trees and a stonewall owned by Mr. Sartonia, just east of Staffordville post office. There were 10 other colonies of between 30 and 40 egg-clusters each. Thirty-four places were sprayed late in June by State men.

Vernon—2 Infestations—47 Egg-clusters

Vernon was scouted by State men, the work being completed on February 7. Two infestations were found; one, a single egg-cluster, on a white oak, on town property in the village of Rockville. The other contained 46 egg-clusters found in four white oak trees on land owned by Otto Broll, near the center of the town. This colony was sprayed by State men on June 29.

Hartford County

Avon

The work in Avon was confined to the territory around last year's infestation. Three miles of roadside and several acres of woodland were scouted and no egg-clusters found.

Berlin

Berlin was scouted by State men and the work finished on May 14. No infestations were found.

Bloomfield—3 Infestations—25 Egg-clusters

State men finished scouting in Bloomfield on January 5. Three small infestations were found; one was a colony of 11 egg-clusters on oak and ash trees in a pasture owned by J. G. Hawley, just east of the railroad on State road leading from Bloomfield to Blue Hills Avenue, Hartford. Another colony of 11 egg-clusters was found one mile further south on the east side of the

railroad in apple trees owned by A. Corte & Son. The third was a colony of three egg-clusters found on oaks owned by Mr. Fuller, near the Simsbury line on the south side of the State road leading from Bloomfield to Simsbury. Two places were sprayed on June 17 and 18 by State men.

East Granby—2 Infestations—8 Egg-clusters

The two infestations found this year in East Granby were both reinfestations. At Mr. Vitten's place just north of the post office, eight egg-clusters were found on willow trees. Larvae were found at Mr. E. W. Kellogg's place later in the spring, so spraying was done at both places on June 19 by State men.

East Hartford—1 Infestation—16 Egg-clusters

One colony of 16 egg-clusters was found in East Hartford this year in the southern end of the town in the margin of a swamp on land owned by H. C. Keeney. This colony was sprayed on June 15. All work in the town was done by State men.

East Windsor—4 Infestations—107 Egg-clusters

All four infestations found in East Windsor this year were in one group located near the center of the town. The largest was in white oak trees at Mr. C. S. Clapp's place, where 69 egg-clusters were found. Another of 22 egg-clusters was found in oaks and ironwood trees at Mr. R. H. Bartlett's. The next largest was a colony of 13 egg-clusters in a pasture white oak owned by Oliver Fenton. The fourth infestation was a colony of three egg-clusters in a white oak owned by F. N. Barber. The two largest colonies were sprayed on June 17 by State men.

Enfield—1 Infestation—2 Egg-clusters

Only one infestation was found in Enfield this year by the State crew that scouted the town. One old and one new egg-cluster were discovered on one oak and a maple tree owned by F. M. Davis, in Hazardville. No spraying was thought necessary.

Farmington—1 Infestation—9 Egg-clusters

The infestation in Farmington this year was a reinfestation of last year's colony in the northeastern corner of the town in woodland owned by Mr. Charles Beach. Three old and six new egg-clusters were found on oak, pine and spruce trees, and on June 12, a State crew sprayed about two and one-half acres of woodland in and around this colony.

Granby—8 Infestations—312 Egg-clusters

Eight infestations were found this year by State men in Granby, with a total of 312 egg-clusters. Of this total, 288 egg-clusters were found in three of the colonies. At the largest colony, 195 egg-clusters were found in woodland owned by Max Shinder, in the southwestern corner of the town. Another colony of 73 egg-clusters was found in one apple tree in the margin of a woodland owned by Edwin Dewey, one-half mile north of West Granby post office. The third was a colony of 20 egg-clusters in an apple tree owned by Francis Spring, near the Suffield town line in the northeastern corner of the town. Four places were sprayed by State men on June 20.

Hartford—9 Infestations—149 Egg-clusters

Although one more infestation was found in Hartford this year than in 1923, the total number of egg-clusters was greatly decreased; in fact 894 less egg-clusters were found this year than in 1923. The colony on the river flats just east of the Fuller Brush plant was again the largest infestation found in Hartford. Ninety-nine egg-clusters were found this year, where last year there were 936. Considering the difficulties met in handling this infestation, the results of last year's work are considered very satisfactory. Another colony of 22 egg-clusters was found on maple and poplar trees at No. 46 Vernon Street. The next largest was a colony of 10 egg-clusters found on elm and willow trees, on Flatbush Avenue. The six other infestations were all small, three of them being single egg-cluster infestations. Eight of the places were sprayed by State men about the middle of June.

Manchester

The scouting in Manchester this year was not completed, and only 12 miles of roadside covered, when the men had to be taken to fill vacancies in other crews, and before the work could be taken up again, the spraying season started. No gipsy moth infestation was found in the town as far as it was scouted.

New Britain—3 Infestations—15 Egg-clusters

Three small infestations were found in New Britain, the largest being at last year's colony on Bassett Street, opposite the High School. Nine egg-clusters were found on oak and pear trees here, where 110 were found last year. The other two infestations were on Washington Street, about one mile north of the colony just mentioned. One contained five egg-clusters on maple shade trees on city property, and the other was a single egg-cluster in an apple tree owned by John Cill. Two colonies were sprayed by State men on June 11.

South Windsor—3 Infestations—40 Egg-clusters

Three colonies were discovered this year in South Windsor by a State crew. One colony of 24 egg-clusters was on poplar, apple, locust and plum trees in the northwestern corner of the town. Another of 13 egg-clusters was found on a roadside apple tree owned by T. E. Sheppard, in the northern part of the town near the East Windsor line. The third contained three egg-clusters on three apple trees owned by Charles Parker, in the southeastern end of the town near the Manchester town line. All three places were sprayed on June 16 by State men.

Suffield—10 Infestations—784 Egg-clusters

Four of the 10 infestations found this year in Suffield were large ones although easily handled, as they were all on trees in open country. The largest was a colony of 371 egg-clusters in willow trees along the brook running parallel with the railroad just north of West Suffield village. Another colony of 143 egg-clusters was found a little further up the same brook on willow, white oak and walnut trees owned by Henry Barr. Another colony of 132 egg-clusters was found in one white oak on land owned by O. R. Austin, about three miles north of West Suffield village. The fourth largest colony was on oak trees in a pasture owned by Henry Sheldon, near the East Granby town line on the State road leading from West Suffield to East Granby, where 114 egg-clusters were found. Three infestations were sprayed in June by State men.

Simsbury—3 Infestations—72 Egg-clusters

Two of the infestations were found in the northwestern corner of the town, one of 32 egg-clusters and one of 11 egg-clusters, both in woodland owned by G. P. McLean and Mr. Furlong. The third colony was in apple trees owned by John Kilikoelski, in the extreme southern margin of the town, where 29 egg-clusters were found. Two of the colonies were sprayed in June by State men.

Wethersfield—2 Infestations—3 Egg-clusters

Both infestations were close together in the east end of the village near the Connecticut River, in the same locality where last year's big infestation of 622 egg-clusters occurred. Two egg-clusters were found at one place and one at the other. Both places were scouted for larvae on June 10, and as none were found, no spraying was thought necessary.

Windsor—2 Infestations—54 Egg-clusters

A State crew completed the scouting in Windsor on October 18. One colony of 46 egg-clusters in one white oak owned by Howard Throth, and another of eight egg-clusters on two roadside apple trees, were found. Both of the colonies were situated in about the center of the town, and were sprayed on June 18 by State men.

Four other towns in Hartford County were scouted by State crews, namely: Plainville, Rocky Hill, Southington and Windsor Locks, and no trace of the gipsy moth found in them.

MIDDLESEX COUNTY

Scouting was completed in the following six towns in Middlesex County this year by State crews: Clinton, Cromwell, Killingworth, Middlefield, Portland and Westbrook; nothing was found in any of them.

In Middletown, on account of the lateness of the season, scouting had to be confined to the sections around last year's infestations. Two egg-clusters were found at Mr. Johnson's place near Bear Hill; later larvae were found at this place, so spraying was done by State men on June 9.

NEW HAVEN COUNTY

Twenty towns were scouted this year in New Haven County by Federal and State crews: two towns were found infested, namely: Meriden and New Haven.

Meriden—1 Infestation—11 Egg-clusters

One colony of 11 egg-clusters was found in Meriden on poplar and maple trees on East Main Street, and on the property of St. Paul's Church, Curtis Memorial Library and Municipal building. The egg-clusters were scattered over the entire block and the infestation was sprayed on June 6 and 8 by State men.

New Haven—1 Infestation—120 Egg-clusters

A large colony of 120 egg-clusters was found in New Haven by Federal men in oak, elm and poplar trees owned by Mrs. R. Wood, at 603 Winchester Avenue. Spraying was done in a large area around the outside of this infestation in the early part of June by Federal men.

The following towns in New Haven County were scouted by State crews and nothing found: Cheshire, Wallingford, and Waterbury. Federal men scouted the towns of Ansonia, Beacon

Falls, Bethany, Derby, East Haven, Hamden, Middlebury, Milford, Naugatuck, Orange, Oxford, Prospect, Seymour, Southbury and Woodbridge, and found them free from gipsy moth infestation.

LITCHFIELD COUNTY

Barkhamsted—4 Infestations—131 Egg-clusters

Barkhamsted was scouted by State men and two large colonies were found in the southeastern end of the town; one of 70 egg-clusters was in woodland owned by Mrs. P. Perry; the other of 50 egg-clusters was in an orchard owned by John Lowander. Another smaller colony of nine egg-clusters was found in woodland owned by the Hartford Water Company, just east of Pleasant Valley. The fourth infestation was one of two egg-clusters found on two maples in a field owned by J. Legett, in the northeastern end of the town. All four of the infestations were sprayed in June by State men.

Canaan

Canaan was scouted by Federal men in the late spring. No egg-clusters were found, but at one 1923 infestation, larvae were found feeding, so 35 shade and 10 apple trees were sprayed in June.

Colebrook—4 Infestations—23 Egg-clusters

All four of the infestations found this year in Colebrook were small. They were in two groups of two infestations each. One group was in the extreme northeastern corner of the town, and both infestations were in woodland. The largest was a colony of five egg-clusters on land owned by Joe Tiller, and the other, one of four egg-clusters, was on land owned by Mr. Howell. The other group was in the western margin of the town; one colony of 12 egg-clusters was found on a maple tree and in a stonewall at Mr. McKenzie's place; the other was a colony of two egg-clusters in woodland owned by L. J. Phelps. Three places were sprayed June 24 by State men.

Cornwall—2 Infestations—23 Egg-clusters

Cornwall was scouted by Federal men, and two infestations were found. One of 19 egg-clusters was in woodland owned by J. Grusanski, in the southern end of the town about two miles east of Swift Bridge; the other was a colony of four egg-clusters on land owned by Constant Beauty, about one mile east of Cornwall Center. The larger colony was sprayed by Federal men.

New Milford—1 Infestation—3 Egg-clusters

Federal men in scouting New Milford this year, discovered three egg-clusters at last year's colony on Mr. F. L. Wanger's place, where 35 egg-clusters were found last year. It was sprayed in June by Federal men and it is hoped that the colony has been eradicated.

Norfolk—15 Infestations—286 Egg-clusters

All but one of the infestations found in Norfolk were situated in the northern half of the town. One small colony of five egg-clusters was found in woodland owned by Mrs. Spofford and the Norfolk Water Company in the southeastern corner of the town. Four of the colonies were large for this part of the State, but a large amount of spraying was done this year and it is hoped that most of the infestations have been cleaned up. The largest colony found was one of 83 egg-clusters in mixed woodland growth owned by E. H. Peasley, in the northeastern part of the town. The next largest contained 48 egg-clusters, in woodland and an orchard near the Massachusetts line in the northwestern corner of the town. A colony of 31 egg-clusters was found in willow and apple trees owned by Carl Stoeckel and Mr. Carlson, about one mile north of Norfolk post office. Another colony of 30 egg-clusters was discovered just north of the village of Norfolk in woodland owned by E. M. Shepard. These four colonies and 10 other smaller infestations were sprayed by Federal men.

North Canaan—2 Infestations—146 Egg-clusters

The work in North Canaan was all done by Federal men this year. Two infestations were found close together in the eastern end of the town near the Norfolk line, both in woodland. Four egg-clusters were found at Mr. Pescidar's place and 142 on the property of C. Rosier, and both places were sprayed.

The following towns in Litchfield County were scouted and nothing found: (by State men), Plymouth and Thomaston: (by Federal men), Bethlehem, Bridgewater, Kent, Morris, Roxbury, Salisbury, Sharon, Warren, Watertown, Washington and Woodbury.

FAIRFIELD COUNTY

Sixteen towns in Fairfield County were scouted by Federal crews this year, namely: Bethel, Brookfield, Bridgeport, Danbury, Easton, Fairfield, Monroe, Newtown, New Fairfield, Redding, Shelton, Sherman, Stratford, Trumbull, Weston and Westport. No gipsy moth infestations were found in the county.

The statistics of infestations, and work done in the towns covered, are given in the following tables:

STATISTICS OF INFESTATIONS, 1924-25

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Windham County:						
Brooklyn	27	903	16	781	16	47
Killingly*	43	1,676	21	277	462	116
Plainfield*	21	428	12	250	206	99
Pomfret	71	2,109	24	575	183	110
Putnam	68	1,956	42	629	980	84
Scotland	0	0	0	0	0	42
Sterling	2	82	2	25	3	56
Thompson*	103	5,256	22	964	1,094	131
Woodstock*	41	3,902	13	450	11,741	94
	376	16,312	152	3,951	14,685	779
New London County:						
Colchester	5	394	4	925	64	134
Franklin	5	18	2	150	0	48
Griswold	3	54	2	16	18	37
Groton*	2	27	1	12	47	12
Lisbon†	0	0	0	0	0	285
Salem	0	0	0	0	0	54
Stonington*	1	19	1	50	171	19
	16	512	10	1,153	300	489
Tolland County:						
Andover	1	30	1	12	0	41
Bolton	1	26	1	100	0	53
Columbia	2	175	2	150	48	54
Ellington	11	97	7	125	0	95
Hebron	1	12	1	25	0	68
Somers	16	81	6	118	0	82
Stafford	55	1,290	34	597	486	165
Vernon	2	47	1	81	0	81
	89	1,758	53	1,208	534	639
Hartford County:						
Avon	0	0	0	0	0	3
Berlin	0	0	0	0	0	88
Bloomfield	3	25	2	100	0	72
East Granby	2	8	2	87	26	50
East Hartford	1	16	1	62	0	59
East Windsor	4	107	2	50	1	74
Enfield	1	2	0	0	0	87
Farmington	1	9	1	200	39	89
Granby	8	312	4	100	98	90

* Work done by Federal scouts.
† Patrolled 1923 infestation.

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Hartford County—*cont.:*						
Hartford ...	9	149	8	1,037	8	128
Manchester ..	0	0	0	0	0	12
New Britain.	3	15	2	425	221	58
Plainville ...	0	0	0	0	0	30
Rocky Hill ..	0	0	0	0	0	44
Simsbury ...	3	72	2	87	2	94
Southington .	0	0	0	0	0	73
South Windsor	3	40	3	75	8	79
Suffield	10	784	3	131	3,450	88
Wethersfield .	2	3	0	0	0	53
Windsor Locks	0	0	0	0	0	26
Windsor	2	54	2	37	0	70
	52	1,596	32	2,391	3,853	1,367
Middlesex County:						
Clinton	0	0	0	0	0	37
Cromwell ...	0	0	0	0	0	52
Killingworth .	0	0	0	0	0	62
Middlefield ..	0	0	0	0	0	33
Middletown*.	0	0	1	62	1	..
Portland	0	0	0	0	0	78
Westbrook ..	0	0	0	0	0	29
	0	0	1	62	1	291
New Haven County:						
Ansonia* ...	0	0	0	0	0	52
Beacon Falls*	0	0	0	0	0	21
Bethany*	0	0	0	0	0	62
Cheshire	0	0	0	0	0	43
Derby*	0	0	0	0	0	35
East Haven*.	0	0	0	0	0	40
Hamden* ...	0	0	0	0	0	115
Meriden	1	11	1	290	225	147
Middlebury*.	0	0	0	0	0	60
Milford*	0	0	0	0	0	85
Naugatuck* .	0	0	0	0	0	73
New Haven*.	1	120	1	125	0	90
Orange*	0	0	0	0	0	111
Oxford*	0	0	0	0	0	80
Prospect* ...	0	0	0	0	0	43
Seymour* ...	0	0	0	0	0	50
Southbury* .	0	0	0	0	0	120
Wallingford .	0	0	0	0	0	134
Waterbury ..	0	0	0	0	0	147
Woodbridge*	0	0	0	0	0	55
	2	131	2	415	225	1,563

* Scouted only around old infestation.

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Litchfield County:						
Barkhamsted.	4	131	4	268	22	97
Bethlehem* .	0	0	0	0	0	53
Bridgewater*.	0	0	0	0	0	50
Canaan*	0	0	1	150	0	60
Colebrook ..	4	23	3	150	2	77
Cornwall* ..	2	23	1	150	0	104
Kent*	0	0	0	0	0	90
Morris*	0	0	0	0	0	50
New Milford*	1	3	1	187	0	177
Norfolk* ...	15	286	14	5,244	0	93
North Canaan*	2	146	2	412	0	56
Plymouth ...	0	0	0	0	0	98
Roxbury* ...	0	0	0	0	0	74
Salisbury* ..	0	0	0	0	0	112
Sharon*	0	0	0	0	0	144
Thomaston ..	0	0	0	0	0	56
Warren*	0	0	0	0	0	64
Washington*.	0	0	0	0	0	111
Watertown* .	0	0	0	0	0	90
Woodbury*..	0	0	0	0	0	100
	28	612	26	6,561	24	1,756
Fairfield County:						
Bethel*	0	0	0	0	0	49
Bridgeport*..	0	0	0	0	0	117
Brookfield* ..	0	0	0	0	0	68
Danbury* ...	0	0	0	0	0	164
Easton*	0	0	0	0	0	81
Fairfield*	0	0	0	0	0	128
Monroe*	0	0	0	0	0	75
New Fairfield*	0	0	0	0	0	52
Newtown* ..	0	0	0	0	0	180
Redding* ...	0	0	0	0	0	96
Shelton*	0	0	0	0	0	89
Sherman* ...	0	0	0	0	0	49
Stratford* ..	0	0	0	0	0	58
Trumbull* ..	0	0	0	0	0	66
Weston*	0	0	0	0	0	53
Westport* ..	0	0	0	0	0	90
	0	0	0	0	0	1,415

SUMMARY OF STATISTICS

County	No. Towns Covered	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Windham	9	376	16,312	152	3,951	14,685	779
New London	7	16	512	10	1,153	300	589
Tolland	8	89	1,758	53	1,208	534	639
Hartford	21	52	1,596	32	2,391	3,853	1,367
Middlesex	7	0	0	1	62	1	291
New Haven	20	2	131	2	415	225	1,563
Litchfield	20	28	612	26	6,561	24	1,756
Fairfield	16	0	0	0	0	0	1,415
	108	563	20,921	276	15,741	19,622	8,399

Quarantine

The Federal forces again scouted the towns of Cheshire and Wallingford, and as no gipsy moth infestations were found, these towns have been released from the Federal quarantine.

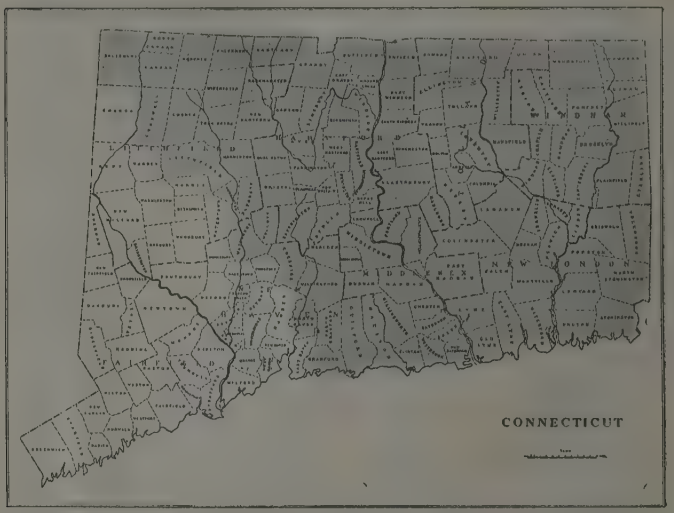

Fig. 41.—Map of Connecticut. The shaded portion represents the area quarantined on account of the gipsy moth. Late in the season the towns of Cheshire and Wallingford were released from quarantine, but are not so designated on this map.

Parasites

Each year for several years, parasites reared at the Federal Parasite Laboratory, Melrose Highlands, Mass., have been liberated in Connecticut. The names of the species and the names of the towns where liberated, together with the number of individuals liberated in each town, have been published in preceding reports. In 1925, only one species, an egg parasite, *Anastatus bifasciatus* Fonsc., was liberated in Connecticut, and colonies were planted in 40 towns in six counties by Mr. McEvoy. The following list gives the names of the towns where these parasites were liberated in 1925, and the number liberated in each town:

Gipsy Moth Parasites Liberated in Connecticut

Year Ending June 30, 1925

County	Town	Anastatus bifasciatus	
New London	Bozrah	3,000	
	Colchester	13,000	
	East Lyme	10,000	
	Franklin	11,000	
	Groton	14,000	
	Lisbon	5,000	
	Montville	6,000	
	Old Lyme	5,000	
	Preston	58,000	
	Salem	1,000	
	Sprague	2,000	
	Waterford	2,000	130,000
Hartford	Berlin	15,000	
	Bloomfield	3,000	
	East Granby	5,000	
	East Hartford	8,000	
	East Windsor	5,000	
	Enfield	1,000	
	Farmington	3,000	
	Glastonbury	8,000	
	Granby	17,000	
	Hartford	17,000	
	Hartland	7,000	
	Manchester	6,000	
	New Britain	7,000	
	Newington	7,000	
	Simsbury	8,000	
	South Windsor	1,000	
	Suffield	8,000	
	West Hartford	3,000	
	Wethersfield	1,000	
	Windsor	4,000	134,000
Tolland	Andover	3,000	
	Bolton	6,000	
	Hebron	3,000	
	Vernon	2,000	14,000
Litchfield	Barkhamsted	7,000	
	Colebrook	6,000	13,000
New Haven	Meriden	2,000	2,000
Middlesex	Middletown	8,000	8,000
			301,000

GIPSY MOTH SUPPRESSION ACCOUNT

FINANCIAL STATEMENT

Receipts

Appropriation for biennial period ending June 30, 1925	$100,000.00
Expended, year ending June 30, 1924	41,798.01
Balance	$58,201.99

Classified Expenditures for the Year Ending June 30, 1925

Salaries and Wages		$42,934.99	
Printing and Illustrations		73.88	
Postage		.65	
Stationery		53.28	
Telegraph and Telephone		34.87	
Insurance		170.90	
Spraying Supplies		1,300.00	
Machinery, Tools and Supplies		1,467.81	
Express, Freight and Cartage		6.74	
Rental and Storage		818.68	
Automobiles: New	$3,715.00		
Insurance	482.49		
Repairs	1,636.87		
Supplies and Equipment	1,619.96		
Gasoline	2,139.56		
Oil	712.51		
		10,306.39	
Traveling Expenses		467.18	
Inspection of Imported Nursery Stock		169.39	
Heat and Light		173.64	
Miscellaneous		.85	
			$57,979.25
Balance			222.74
			$58,201.99

FURTHER EXPERIMENTS IN DUSTING AND SPRAYING APPLE ORCHARDS

Season of 1925

BY M. P. ZAPPE AND E. M. STODDARD

The experimental work with dusts and liquid sprays begun in 1920 was continued in 1925, the chief object being to make further tests of combined dust and spray treatments. Consequently the plots receiving only dust and others receiving only spray were continued for purposes of comparison, and in addition several combinations of spray and dust were tested.

The results of former tests made at this Station have been published in the Station bulletins and reports as follows: Report for 1920, page 168, results of 1920; Bulletin 235, results of 1921; Bulletin 245, results of 1922; Report for 1923, page 267, results for 1923; Report for 1924, page 286, results of 1924.

Orchard Under Experiment

The orchard of Mr. Frank N. Platt, Milford, which has been employed in preceding tests, was also used in 1925. It contains about 285 trees, 21 years old. The varieties selected for the test in 1925 were Baldwin, Greening and McIntosh.

Acknowledgments

The writers are indebted to Mr. Frank N. Platt for the use of his orchard, power sprayer, and assistance in conducting the tests, and to Messrs. B. H. Walden, Philip Garman and J. L. Rogers, who assisted in scoring the fruit at harvest time.

Method of Recording Data

Trees which blossomed freely were selected as count trees. The ripe fruit was harvested and left in baskets under the tree from which it was picked and each apple scored for insect and fungous injury. All injuries on each fruit were recorded even though slight, and often several kinds of injury were noted on a single apple; in such cases all types of injury were recorded separately. Later these figures were tabulated and percentages obtained. Altogether, this work necessitated the separate handling and scoring of 136,486 individual apples, equivalent to about 341 barrels.

In scoring fruit, we use a sorting table at which four men can work conveniently. Each apple is examined and the injury recorded on a score board; if the apple is perfect this fact is recorded. The score board consists of a series of tallying registers which are mounted on a board for convenience, as shown on Plate V, b. In front of each register is the name of the injury to be recorded on that particular register. The men doing the scoring of the fruit call off the injury to another man who does nothing but record the data as it is given, or the board may be placed on the sorting table and each man who scores can record his own data. On check trees where injuries are numerous and of various kinds, they are recorded singly for each fruit. Where injuries are mainly of one or two kinds, they are often recorded in lots of five. In this case a scorer holds the type of injury, or good apples as the case may be, in one hand until he has five, and then records it by pressing the lever of the register once, it being understood that each figure on that register represents five apples or five injuries.

Often several kinds of injury are found on one apple; in this case each type of injury is recorded and the register marked "Duplicate" must be punched once for each injury except the first one. When the results are tabulated, the number on the

"Duplicate" register subtracted from the total number of injuries will give the total number of apples scored. This figure must be known when the percentages are worked out.

After all the fruit from a certain tree has been scored, the figures on the tallying registers are recorded on score sheets which are carried in a shallow drawer under the score board, and are fastened to the top of the board by thumb tacks when in use, (see Plate V, b).

The number of registers needed on the score board depend upon the kind of fruit to be scored. When scoring apples, from eight to ten registers are needed, and for peaches, five or six are sufficient. Oftentimes some of the registers may be used to indicate the degree of injury: whether light, medium or heavy. In scoring apples for curculio injury, the number of scars can be easily recorded by the use of these registers.

Materials and Apparatus Used

The 90-10 sulphur dust which former tests have shown to be the best adapted for Connecticut conditions was the only dust used in 1925. This contains 90 parts of sulphur and 10 parts of lead arsenate, by weight.

Materials used in the liquid spray were as follows:

Dry lime-sulphur	6 pounds
Lead Arsenate	3 pounds
Casein spreader*	1 pound
Water	100 gallons

The spray outfit was the same as used in the preceding experiments, a 200 gallon Friend power sprayer carrying two lines of hose with rods and nozzles. The duster was a 1923 model Niagara power outfit, mounted on an automobile truck.

Arrangement of Plots in the Platt Orchard

This orchard was divided into six plots of two rows each, with the varieties running across the rows, so that all varieties were represented in each plot. Rows A and B were sprayed throughout the season; rows C and D were dusted with 90-10 dust the entire season; rows E and F were sprayed at the prepink, pink and calyx treatments, and were dusted three times afterwards; rows F and H were sprayed at prepink and third treatment after calyx, and dusted at pink, calyx, first and second treatments afterwards; rows I and J were dusted at the prepink, calyx and second treatment after calyx, and sprayed at the pink and first and third treatments after calyx; row M was a check row and received no treatment.

* Used only on a portion of one plot.

Application	Date	Rows A & B	Rows C & D	Rows E & F	Rows G & H	Rows I & J	Row M	Varieties Treated
No. 1 Prepink	Apr. 27	Spray	Dust	Spray	Spray	Dust	Check	McIntosh only
No. 2 Pink	May 1	Spray	Dust	Spray	Dust	Spray	Check	All varieties
No. 3 Calyx	May 15	Spray	Dust	Spray	Dust	Dust	Check	All varieties
No. 4, 1st after calyx	June 3	Spray	Dust	Dust	Dust	Spray	Check	All varieties
No. 5, 2d after calyx	July 1	Spray	Dust	Dust	Dust	Dust	Check	All varieties
No. 6, 3d after calyx	July 27	Spray	Dust	Dust	Spray	Spray	Check	All varieties

The sprayed plot was divided into two sections, one with and the other without casein spreader.

The numbers designating the applications may be explained as follows; 1, prepink; 2, pink; 3, calyx; 4, first treatment after calyx; 5, second treatment after calyx; 6, third treatment after calyx.

RESULTS OF TREATMENT ON MCINTOSH

	Spray No Casein	Spray Casein	Dust	Spray 1, 2, 3 Dust 4, 5, 6	Spray 1 and 6 Dust 2, 3, 4, 5	Spray 2, 4, 6 Dust 1, 3, 5	Check
Good	86.5	90.5	88.8	89.5	80.9	79.	.86
Scab	6.4	2.7	2.08	1.2	6.35	7.7	51.7
Aphis	1.76	3.5	3.21	3.20	4.38	5.56	4.79
Red bug	.86	.8	.34	.81	.63	.35	2.25
Codling moth	.01	.04	.27	.16	.15	.01	4.29
Curculio	3.42	2.1	4.57	3.92	5.18	6.12	29.6
Other chewing insects	1.45	.5	1.37	1.33	2.52	1.2	6.48

DISCUSSION OF RESULTS

There are no striking results from any one treatment shown in this table, there being only small differences in the percentages of good fruit from the various treatments. The difference between the highest and lowest percentage of good fruit is only about 11 per cent. In the sprayed plot, there was a very slight advantage in the section which had casein spreader in the mixture. The percentage of scab in the treated plots was not high in any case, but in the check plot over one-half of the fruit showed traces of

the disease. The plot receiving only dust treatments had less scab than the dust plots of former years. In the combined spray and dust plots, the one having the early sprays and dust later in the season gave a somewhat higher percentage of good fruit, and a little lower percentage of scabby fruit, than the others.

RESULTS OF TREATMENT ON BALDWIN

	Spray No Casein	Dust	Spray 1, 2 Dust 3, 4, 5	Spray 5 Dust 1, 2, 3, 4	Spray 1, 3, 5 Dust 2, 4	Check
Good	91.27	83.6	87.97	85.25	86.9	1.79
Aphis	.94	1.13	3.93	1.75	3.89	.78
Red bug	1.76	.90	1.44	2.35	.99	2.66
Codling moth	.52	1.67	.74	.36	.23	2.01
Curculio	5.90	9.50	4.27	8.63	5.39	39.3
Other chewing insects	1.66	3.85	2.53	2.13	2.8	19.9
Sooty blotch	0	0	0	0	0	36.2
Fruit speck	0	0	0	0	0	68.6

DISCUSSION OF RESULTS

This variety bore no fruit in the casein spray plot; therefore no figures can be shown. In general the sprayed plot gave a little the highest percentage of good fruit, though the differences are slight. The dusted plot yielded a somewhat lower percentage of perfect fruit and slightly higher percentage of codling moth, curculio and other chewing insect injury, but not enough higher to make any great difference. The combined spray and dust plots were nearly as good as the sprayed plot; in fact there were no very great differences between any of the plots. There was no scab and hardly a trace of sooty blotch and fruit speck on the fruit from any of the treated plots.

RESULTS OF TREATMENTS ON GREENING

	Spray No Casein	Spray Casein	Dust	Spray 1, 2 Dust 3, 4, 5	Spray 5 Dust 1, 2, 3, 4	Spray 1, 3, 5 Dust 2, 4, 6	Check
Good	86.15	92.05	91.1	92.7	91.05	89.5	1.2
Aphis	1.91	2.86	1.50	.68	1.74	2.06	1.29
Red bug	1.13	1.08	.68	.51	.47	.65	4.75
Codling moth	.41	.35	.23	.23	.50	.64	7.74
Curculio	7.89	3.06	4.21	3.91	4.48	5.65	78.0
Other chewing insects	1.99	.84	2.52	1.96	2.01	1.39	21.6
Scab	.96	.04	.05	.25	.21	.23	21.2
Sooty blotch	0	0	0	0	0	0	70.5
Fruit speck	0	0	0	0	0	0	25.0

Discussion of Results

The results on Greening were similar to those obtained on Baldwin, there being no particular plot which was very much better or worse than any of the others. The combination plot receiving early sprays and late dusts gave a slightly higher percentage of good fruit than any others. The spray plot with casein was a little better than that which had no casein in the mixture. The amount of scab on all plots was negligible except in the check, where it ran up to 21 per cent. The check plot also showed 70 per cent. of sooty blotch and 25 per cent. of fruit speck, while the treated plots had none.

Summary and Conclusions

In an attempt to find some way to determine the relative value of different spray treatments, we have devised a method of scoring which seems to give accurately and briefly the desired result. This method consists of listing the treatments and injuries as shown in the table below and checking for each treatment the troubles it controlled the best in comparison with other treatments in the same experiment, and checking for highest percentages of good apples. For example, in the accompanying table, we find from our data that treatment No. 1 best controlled codling moth on McIntosh, and we indicate this under No. 1, opposite codling moth, by a letter M. If two treatments are equally good, each one is checked. The sum of the scores under each treatment give the relative value of each.

	1 Spray No Spreader	2 Spray with Spreader	3 Dust	4 Spray 1, 2, 3 Dust 4, 5, 6	5 Spray 1, 6 Dust 2, 3, 4, 5	6 Spray 2, 4, 6 Dust 1, 3, 5
Good	B	M		G		
Aphis	BM			G		
Red bug			BM		G	
Codling moth	M		G	G		MB
Curculio		GM		B		
Other chewing insects	B	GM				
Scab	B	GB	B	MB	B	B
Sooty Blotch	BGM	BGM	BGM	BGM	BGM	BGM
Fruit Speck	BGM	BGM	BGM	BGM	BGM	BGM
Total score	12	13	10	12	8	9

B = Baldwin G = Greening M = McIntosh

From this table we find that spray with spreader was the most efficient and spray without spreader and combination No. 4 tied for second place, followed by dust and combinations No. 6 and No. 5, in the order named.

Our results are well summarized in the above table as regards effectiveness of treatments, and a few other features not shown in the table will be mentioned briefly in conclusion. Scab was less prevalent than usual in 1925, due to weather conditions unfavorable for infection in the spring, all control measures gave good results and such infection as did occur was light to medium even on untreated trees. Rains and high humidity in early May undoubtedly would have caused a wider difference in favor of spraying. The same is also true of sooty blotch and fruit speck, as a subnormal rainfall in July and August made conditions unfavorable for infection, especially of fruit speck. No nicotine solution was used in the summer applications, but evidently there was some control value in all the treatments especially spraying at the prepink, pink and calyx.

As our work was conducted to collect data on combinations of spray and dust, we would call attention to the combination with the first three applications of spray and the last three of dust which gave results comparable with spray in all six applications. If this gives effective control in a normal scab year and coupled with entire freedom from the chance to burn the foliage in midsummer, this combination ought to prove satisfactory.

EFFICIENCY OF DELAYED DORMANT APPLICATIONS FOR THE CONTROL OF APPLE APHIDS

By M. P. Zappe and E. M. Stoddard

It is a fact well known among fruit growers that at the time that the delayed dormant sprays are applied, most of the apple aphids have hatched.

It should be understood that the following three species of aphids infest the apple, and their eggs hatch in the order given: (1) spring grain aphid, *Toxoptera graminum* Rondani; (2) green apple aphid, *Aphis pomi* DeGeer; (3) rosy apple aphid, *Anuraphis roseus* Baker. All species are sometimes present on the buds, but the green apple aphid is the commonest species and the spring grain aphid, which is not injurious to the apple, was not abundant in Connecticut apple orchards in 1925. As the rosy aphid, the most injurious species, does not hatch until rather late, usually when the tips of the leaves are perhaps half an inch long, it is important that the treatment be delayed until late enough to kill the young rosy aphids after the eggs have hatched. These aphids may be found clustered on the tops of the swelling buds

and occasionally some may be seen crawling along the twigs from one bud to another. At this time they are unprotected by any foliage and an application of the proper spray, thoroughly applied, will give more satisfactory control than later sprays, especially after the aphids have begun to curl the leaves around themselves.

In order to compare some of the ordinary dormant sprays for aphid control, we sprayed the orchard of Mr. Frank N. Platt at Milford. Four varieties of apples were used in the tests: McIntosh, Baldwin, Greening and Gravenstein. The orchard was divided into four plots which were treated as follows:

Plot I Dry lime-sulphur, 12 lbs. to 100 gals. water
Plot II Dry lime-sulphur, 12 lbs. to 100 gals. water, and 1 pint nicotine
Plot III Sunoco spray oil, 1 part to 20 parts water
Plot IV Check (no treatment)

The spray applications were made on April 14 and 15, using a Friend 200-gallon power sprayer. Two lines of hose with rods and two nozzles at each rod were used. At this time the buds were just beginning to show the green tips of the young unfolding leaves, and aphids that had hatched were clustered on the tops of the buds.

A little later in the season, on May 8, after the aphids had begun to reproduce, several trees in each plot were selected at random and 100 twigs per tree were scored for aphids. The terminal leaves on the selected twigs were examined and were classified as having no aphids, light, medium or heavy infestation.

The following tables show the number of terminal twigs examined and the results:

DRY LIME-SULPHUR AND NICOTINE

Variety	Light	Medium	Heavy	None	Total Infestation Per Cent
Greening	44	10	6	40	60
Baldwin	40	10	0	50	50
Gravenstein	44	12	8	36	64
McIntosh	44	14	10	32	68
Average for all varieties	43	11.5	6	39.5	60.5

DRY LIME-SULPHUR, NO NICOTINE

Variety*	Light	Medium	Heavy	None	Total Infestation Per Cent
Greening	60	14	6	20	80
Baldwin	62	16	8	14	86
McIntosh	72	8	6	14	86
Average for all varieties	64.6	12.6	6.6	15.3	84

* No Gravenstein trees in this plot.

SUNOCO SPRAY OIL

Variety	Light	Medium	Heavy	Total Infestation None	Total Infestation Per Cent
Greening	26	4	0	70	30
Baldwin	48	0	2	50	50
Gravenstein	66	12	4	18	82
McIntosh	42	4	2	52	48
Average for all varieties	45.5	5	2	47.5	52.5

CHECK

Variety	Light	Medium	Heavy	Total Infestation None	Total Infestation Per Cent
Greening	62	28	4	6	94
Baldwin	60	20	10	10	90
Gravenstein	40	36	16	8	92
McIntosh	56	12	8	24	70
Average for all varieties	54.5	24	9.5	12	88

SUMMARY

It may be seen from the foregoing tables that Sunoco spray oil at the strength of one part oil to 20 parts water was the most efficient of the sprays used for the control of aphids at the delayed dormant period. Lime-sulphur and nicotine was second best. Lime-sulphur without the nicotine was only a little better than the check trees.

The Gravenstein variety seems to be very susceptible to aphid attacks, while the McIntosh seems to be more immune. This is not only true of aphid infestations of leaves, but in former experiments has often been found to hold true of aphid injured fruit, the Gravenstein apples showing great distortion by this insect, while the McIntosh fruit shows very little.

It therefore seems very important that greater efforts be made to control aphids on Gravenstein than on McIntosh.

If the fruit grower contemplates using nicotine in his sprays, we feel that it is best to use it in the delayed dormant, prepink and pink sprays, or even in the calyx spray, if aphids are plentiful enough at this time to warrant the expense. In later sprays than these, it is of doubtful value; in fact it is almost useless to try to control aphids after the trees are in full leaf.

THE ORIENTAL PEACH MOTH IN 1925

PHILIP GARMAN

The Oriental peach moth continued to do damage in Connecticut in 1925 and increased considerably in severity in the Wall-

ingford section. In the course of experimental work, wormy fruit was found amounting to 46 per cent. in one orchard. Though not nearly as severe in other orchards, yet the damage was enough to be noticed and commented upon. In some orchards no increase was noticed over last year.

Spraying operations were conducted in two different orchards and life history work was carried on at the Station, supplemented by many field observations. The first adult emerged from hibernation May 5, and adults continued to emerge until June 11. Eggs of the first generation were deposited beginning May 15, continuing until June 17. The first brood (from egg to adult) extended in 1925 from May 15 until July 19. Second brood eggs were laid, beginning June 27 continuing until July 22, the brood extending from June 27 until August 20. The third brood eggs were laid, beginning July 28 and continuing until August 27. Many of the larvae of this generation hibernated but some emerged, producing a fourth or partial fourth generation. According to our records this partial fourth generation began September 6, the first egg being obtained on that day. Whether many of this brood actually reach maturity and hibernate has not been determined for Connecticut. The last adult emerged September 20, and adults were trapped in the orchards September 21. All data obtained is illustrated graphically in Figure 42, the stippled areas indicating the probable extent of the stage in cases where insectary data is apparently incomplete. About 1,500 eggs in all were obtained from moths in captivity and over 500 individual cages were handled in obtaining the records.

Several parasites have been reared from the insect, as follows:

Eubadizon sp. A parasite overwintering in the cocoon of the host and emerging in spring about the time the moths appear. Adults were obtained May 7 and 8, and August 14. The host material was collected in Wallingford and Greenwich, Connecticut.

Macrocentrus ancylivora Rohwer. A fairly abundant parasite in August emerging July 28 and August 28 from our specimens. This parasite is apparently identical with important parasites found in New Jersey, Maryland and Virginia. It was obtained from host material collected in Wallingford.

Glypta rufiscutellaris (Walsh). Two specimens obtained in Wallingford emerged from the host July 28, 1925.

The control experiments were conducted in the orchard of the Barnes Nursery and Orchard Company at Wallingford through the courtesy of the Messrs. Barnes; and at the Conyers farm orchard at Greenwich through the courtesy of Mr. G. A. Drew. Treatments in both cases were supplementary to the regular treatments given, which in both cases comprised treatments for control of scab and curculio, and in the Conyers farm orchard, a fall

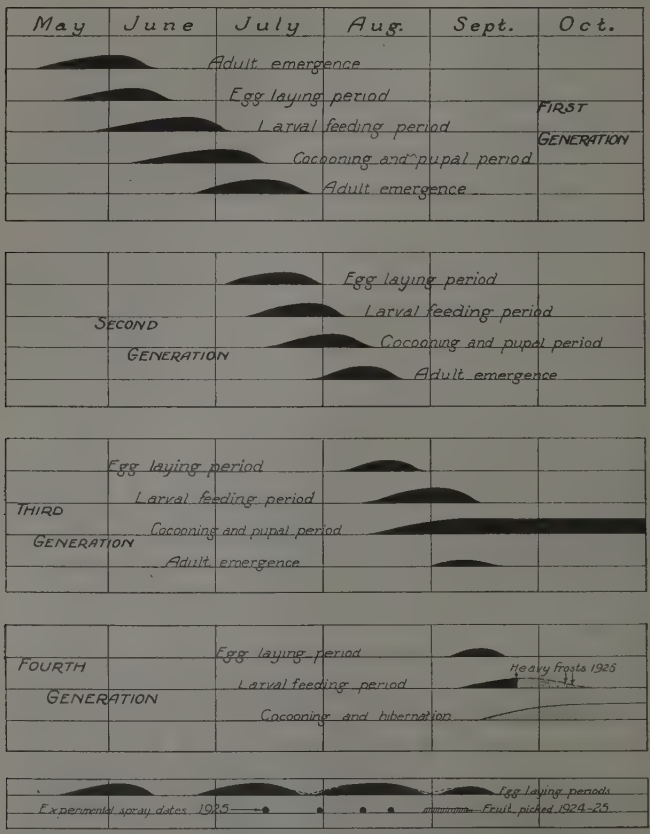

FIG. 42.—Oriental Peach Moth. Preliminary life history chart based on data obtained in 1925. This chart is not intended to give complete results since there are many points which need further study. However, it shows the trend of development in 1925 as correlated with out spray program. The stippled areas are uncertain periods which are indicated by field observation. There is also a possibility that some of the second generation larvae pass the winter, but of this we have not yet secured any evidence for Connecticut. The adult emergence as shown under the head of "first generation" is in reality a part of the third and fourth generations of the previous season. It is shown in this position on the chart for the sake of convenience.

application of lime-sulphur. It will be seen that none of the treatments, or those of last year as shown in Table I, reduced the amount of infested fruit below 10 per cent., and we have been forced to conclude that other measures must be found and that all known means of control must be employed in a severe infestation in order to bring through a larger amount of sound fruit. Consequently tests were made of a number of different insecticides with a view to determining what substances if any would kill the larva before entering or would provide a suitable coating upon which the larva would feed without digging into the peach or twig. Results of these tests are not yet complete. Small bait pans were also employed in the field to determine the possibility of capturing moths by this means, thus reducing the total population of the insect in the orchard. In six small tin buckets hung in a bearing orchard, 283 moths were captured between August 11 and September 1. Honey, water and yeast was first employed, but was later replaced by molasses and water according to the recommendations of Peterson.[1] Adults fly into the mixture, their wings become wet and they are unable to escape. This means of control shows some promise and several investigators are busy working out details of application. It is hoped that it will provide the necessary means of increasing sound fruit and will prove sufficiently economical. The whole problem of control is very difficult owing to the habits of the insect, which seems to have developed almost a perfect defense, and about the best that can be done at the present time is the recommendation of nicotine sprays; cultivation before May 5, so as to bury the larvae to a depth of three inches; treatment with paradichlorobenzene to destroy the larvae hibernating on the trunk near the ground and destruction or removal of drop fruits. Our experiments to date indicate that four sprays containing nicotine sulphate as applied in 1925 gave as good control as five sprays applied in 1924, though at somewhat different intervals. In 1925 these sprays were applied July 13, August 10 and August 20, the fruit being picked the first of September. In 1924, the fruit was picked nearly two weeks later and the final treatments were given August 15. Life history data obtained in Connecticut thus far show that the insect was very abundant in August during 1924 and 1925, and this probably accounts for the favorable results obtained from the treatments in 1925. Considerable foliage injury was noted in the blocks sprayed with nicotine and fish oil soap (potash) which was attributed to an increase of soap in one application (four pounds to 50 gallons of water), since subsequent sprays containing two pounds of soap per 50 gallons did no damage. Sulphur arsenate dusts (acid lead arsenate 10 per cent., sulphur 90 per cent.) caused some of the leaves to turn yellow and drop, although applied

[1] Peterson, A. Journal of Economic Entomology, Vol. 18. 181-190, 1925.

carefully when most of the foliage was dry. This dust in itself is not effective enough and too dangerous to be considered for treatments to control the Oriental peach moth. Nicotine dust caused no noticeable damage, but it is evident that is cannot be used as late as the nicotine soap spray since it has a tendency to cling in the fur of the peach if applied less than three weeks before picking time. This would undoubtedly affect the sale of the fruit. On the other hand, nicotine soap sprays may be applied as late as needed without leaving any undesirable residue on the peaches at harvest time. The nicotine sulphate can probably be added to a fungicide such as self-boiled lime-sulphur or dry mix sulphur lime without decreasing its effectiveness. Very late applications should contain only nicotine sulphate or nicotine sulphate and soap.

TREATMENTS FOR ORIENTAL PEACH MOTH CONTROL, 1924-1925

TABLE I.

Treatment	Farm and Date	No. of Peaches Considered	Total per cent. injured
1. Self-boiled lime-sulphur, June 9 and July 14	Conyers Farm 1924	2,186	23.
2. Nicotine sulphate, self-boiled lime-sulphur, casein lime; July 9 and July 14; nicotine sulphate plus soap, June 30, July 28 and August 15	Conyers Farm 1924	2,167	14.
3. Sulphur arsenate dust followed by nicotine dust, June 9 and July 14; nicotine dust, June 30, July 15 and August 2	Conyers Farm 1924	1,692	11.
4. Nicotine dust, July 13, July 29 and August 10	Conyers Farm 1925	1,964	23.
5. 90-10 sulphur arsenate dust, July 13 and August 10	Conyers Farm 1925	1,932	15.5
6. Nicotine-soap spray, July 13, July 29, August 10 and August 20	Conyers Farm 1925	1,883	10.5
7. Check	Conyers Farm 1925	1,924	21.5
8. 90-10 dust, July 15 and August 14	Barnes Orchard 1925	824	38.
9. Nicotine dust, July 15, July 30 and August 14	Barnes Orchard 1925	755	28.
10. Check	Barnes Orchard 1925	439	46.

TABLE II. BARNES ORCHARD—1925

Treatment Received	Total No. Peaches	No. Good	% Good	New Injury: Side	New Injury: Stem	New Injury: % Side	New Injury: % Stem	New Injury: % New Injury	Old Injury: Side	Old Injury: Stem	Old Injury: % Side	Old Injury: % Stem	Old Injury: % Old Injury	Total Injuries	Total % Injured
90-10 Dust, July 15, August 14	824	511	62.01	22	213	2.66	25.84	28.51	40	46	4.85	5.58	10.43	313	37.98
Nicotine dust, July 15, July 30, August 14	755	544	72.05	15	158	1.98	20.92	22.91	20	18	2.64	2.39	5.03	211	27.94
Check	439	234	53.30	19	129	4.32	29.38	33.71	23	34	5.23	7.74	12.98	205	46.69

TABLE III. CONYERS FARM ORCHARD—1925

Treatment Received	Block No.	Total No. Peaches	No. Good	% Good	New Injury: Side	New Injury: Stem	New Injury: % Side	New Injury: % Stem	New Injury: % New Injury	Old Injury: Side	Old Injury: Stem	Old Injury: % Side	Old Injury: % Stem	Old Injury: % Old Injury	Total Injuries	Total % Injured
Nicotine dust (2.7%), July 13, July 29, August 10	1	1,964	1,514	77.08	1,191	220	6.05	11.206	17.26	66	31	3.36	1.57	4.93	450	22.91
90-10 Sulphur-arsenate dust, July 13, August 10	2	1,932	1,631	84.42	41	215	2.12	11.12	13.25	37	9	1.91	.46	2.38	301	15.57
Check	3	1,924	1,509	78.43	79	266	4.10	13.82	17.93	39	21	2.02	1.09	3.11	415	21.56
Nicotine spray (1 qt.-200 gals.) plus fish oil soap, July 13, July 29, August 10 and August 20	4	1,883	1,685	89.48	37	117	1.96	6.21	8.11	32	7	1.69	.37	2.07	198	10.51

Explanation of Tables II and III

All fruit from these blocks was taken from trees in the center of the block. At Conyers Farm, two baskets were taken from each of 10 selected trees, of approximately equal bearing capacity—the peaches being picked from all parts of the tree and subsequently cut open to determine whether infested or not. There were approximately 60 trees in each block, the trees being of considerable size, as shown in Plate VI. Prevailing winds blew across the blocks from end to end and not from one block to another. The nicotine dust block, however, was alongside of an apple orchard which may in part account for the poor showing made by this method of treatment. Owing to the possibility of allowing dusts to remain on the fruit at picking, it was found necessary to reduce the number of applications as compared with sprays containing nicotine. Only three applications of dust were made as against four sprays. The variety was Belle of Georgia.

The work at Barnes orchard, Table II, was carried out in a similar manner, but the amount of fruit scored was much smaller and the results obtained are not considered to be of as much value as those obtained at Conyers Farm. Prevailing winds in this orchard blew across the three different blocks from the sulphur-arsenate dust plot to the nicotine dust to the check which was at the far side of the orchard. The variety was Elberta.

In both tables, the heading "new injury" is intended to show that made by late entering larvae probably the third brood, and in most cases the larva itself was found. The heading "old injury" refers to old scars usually accompanied by considerable gum indicating that it was caused by the feeding of the first or second brood larvae. In this case the larva was never found within the peach.

THE CURCULIO PROBLEM IN CONNECTICUT

Philip Garman

The plum curculio in Connecticut offers a serious hindrance to the production of perfect apples in many orchards. It is not so much a problem in peach orchards, although it occurs there abundantly, but apparently there is no second brood of larvae and peaches rarely become extensively infested. Certain varieties of plums are naturally attacked, this fruit being a favorite food, but since plums are not grown extensively in Connecticut, the problem of control is not pressing. It is also known to feed upon cherries, apricots and nectarines. On the other hand, a large proportion (often 80 or 90 per cent.) of the apples in a commercial orchard may be deformed or destroyed and a considerable percentage of marred fruit may and often does remain after

thorough spraying. Such conditions to be remedied need the most careful study of the curculio's habits as well as thorough and painstaking application of control methods.

The curculio is one of the oldest pests of apples and other fruits in Connecticut. Mention of it is found in almost all literature dealing with fruit culture dating back as far as colonial times—and strange to say, some of the oldest methods of fighting the insect are often practiced to-day. Arsenical sprays have been mainly developed during the past 60 years and there will no doubt continue to be improvements along these lines, since we are only within recent years becoming acquainted with the feeding habits of the insects in relation to the toxic substances placed on the trees, comparative kill obtained with different products, freedom from spray burn, and many other points essential to the effective and economical use of available poisons. The arsenate of leads which have replaced all other stomach poisons for killing orchard insects, have been developed to a high state of perfection as regards mechanical condition and adhesion; and much more cannot apparently be expected in the poisons themselves. There still remains, however, the possibility by additions of making them attractive for the particular insect, increasing their stay on the trees long enough to cover the period of activity of the pest, or of increasing the thickness of the coating or palatability in some way in order to obtain more satisfactory results.

All poison work as well as other controls, however, must be definitely founded on biological data obtained in the vicinity. It is, for instance, important to know that beetles begin to emerge from hibernation in Connecticut about the first of May or when most apple trees are in the pink bud stage; that they become most abundant on the trees about the 15th or 20th of May (about the time when the blossoms have fallen) and that their period of greatest activity apparently lasts till the middle or last of June, the egg-laying period extending to the second week of July. It is also important to know that larvae develop abundantly in early apple drops and that they begin to leave this fruit the latter part of June, the majority entering the soil by the middle of July and few or none remaining by the first of August; furthermore that beetles again begin to emerge from the soil by the first of August or a little before, but that their maximum emergence appears to lie between the 15th of August and first of September, the beetles hibernating shortly after with a relatively small amount of fall feeding.

Of the control measures commonly practiced, the following may be mentioned: (1) cultural practices, or care of drop fruits—one of the oldest means of control and a very important adjunct to spraying practices especially where curculios are abundant—and one very commonly neglected. To be successful, cultivation

should be completed by the first of August, or if drop fruits only are handled, the operation should probably be complete by the first of July. (2) Spring and early summer applications of arsenicals. To be successful these must be considered from the standpoint of the growing tree and fruit (the tree must be kept thoroughly covered with poison at this time), and from the standpoint of the relative abundance of beetles on the trees. A schedule comprising pink, calyx, 7-day after calyx, and two weeks after calyx, all with arsenate of lead, meets these requirements and will apparently be successful in producing a satisfactory majority (90 per cent.) of clean fruit where the infestation is light or medium. If, however, the infestation is very heavy, even the complete schedule may fail to give the desired freedom and it becomes necessary to apply additional measures to secure relief. Moreover, in some orchards it may be difficult to get over the orchard once a week at the critical time, in which case there are several possibilities. The owner may apply cultural practices as outlined or take care of drop fruit (which if collected should be buried to a depth of two feet so the beetles will not emerge); in small orchards it would be possible to jar the beetles from the trees, collecting and destroying them—a method seldom practiced to-day; or it is possible to spray or dust again in the fall after the beetles have emerged as recommended by Snapp; the latter method offers one serious objection in the case of apples, in that sprays at this time might remain on the fruit at picking time. In the case of peaches or plums, however, this difficulty is not apparent and many beetles can doubtless be killed with a late spray since they feed on the leaves after the fruit is off. (3) There is still another possibility, namely: the treatment of wild apple trees which usually produce annually large numbers of curculios, or the treatment of abandoned or uncared-for orchards which are a decided menace when near a commercial orchard. We have examined many such trees in the neighborhood of well-kept orchards and there can be little doubt that curculios develop there and fly into the commercial orchard, adding much to the troubles of the grower. Hibernating quarters such as fence rows should be cleaned up and stone walls removed if possible.

Two years' experimentation with sprays together with data accumulated by this Department in connection with other work indicate that continued applications year after year give increasing percentages of clean fruit. However during six years' experimental spraying[1] in one of our orchards at Mount Carmel, the desired freedom was secured only after removal of a neighboring peach orchard, (which normally received no arsenical sprays), use of programs planned especially to control curculio, and sys-

[1] Experimental curculio spraying begun in 1924.

tematic collection of early drop fruits from the apples. Data on spraying operations are slowly accumulating under a five-year program and it may be that something will develop that will work effectively in the case of severe infestations without the need of supplementary operations. The difficulties, however, become apparent when we realize that the tree is growing most rapidly at the time of the greatest abundance of the pest, that the average sprays show some repellent action and even if most of the beetles in an orchard are killed, many may come in from outside sources—unless those danger points are considered and treatment provided.

The following bibliography of Experiment Station and other publications dealing with the curculio problem is given as it shows the opinions of State and Federal workers on the subject. It is from these sources that many of the recommendations found in literature to-day are taken.

1905. Crandall, C. S. Illinois Agricultural Experiment Station, Bulletin No. 98. Extensive account of apple and plum curculios with detailed field experiments for control. Spraying operations considered unsuccessful—cultivation recommended.

1906. Crandall, C. S. *Ibid.*, Bulletin 106, pp. 219-231.

1921. Fernald, H. T. In Applied Entomology, pp. 137-139. *Control* (p. 138). "No one method nor even all the methods of control taken together will give entire freedom from this pest. A combination of the treatments however, will accomplish considerable in this line." Recommends removal of rubbish and hibernating quarters; (2) pruning trees to allow sunlight to enter; (3) allowing fowls and hogs to run under trees or through shallow cultivation from time larvae begin to leave fruit till six weeks later; (4) spraying with arsenate of lead "for apples—treatment commonly given for codling moth though similar later applications may also be necessary if the insects are abundant"; (5) jarring the trees and collecting the beetles when only a few trees are involved.

1906. Forbes, S. A. Illinois Agricultural Experiment Station, Bulletin 108. Used arsenicals in field tests against the curculio on apples with an average increase of 63 per cent. sound fruit over untreated trees.

1914. Headlee, T. J. Report of the Department of Entomology, New Jersey Agricultural Experiment Station for 1913, p. 654. States that where curculio is present foliage must be kept covered with arsenical from time the "creature begins to feed until it disappears." Overwintering beetles remain in plum orchards about six weeks, in apple orchards for about a month.

1918. Headlee, T. J. *Ibid.*, Report for 1917, pp. 437-438. "Attack seems to have come between the blossom-fall and the ten-days-after-blossom-fall spraying." "In orchards standing near woodlands or plantings interspersed with old stumps or carpeted with grass, the damage was particularly severe." Recommends clean culture during forepart of season followed by cover crop not producing a dense sod, removal of stumps and cleaning of fence rows. Recommends spraying to preserve the coating intact for the first month after blossoms fall.

1919. Headlee, T. J. *Ibid.*, Report for 1918, pp. 212-213. Recommends 7-day spray after calyx. Records two successful cases of control in orchards where curculios were abundant and where crop unsprayed was "ruined by the curculio." Recommends as a schedule for curculio control

(1) before buds swell; (2) as blossom buds first show color; (3) directly after petals fall; (4) seven days later; (5) 17 days after blossoms fall; (6) June 20 to 30 for all fall and winter varieties. Better results obtained with lime-sulphur and arsenate of lead than with arsenate of lead alone; both have repellent action.

1921. Headlee, T. J. *Ibid.*, Report for 1920, p. 449. Table showing comparison of dust and spray on apples unsatisfactory control of curculios indicated with dust. Seven to nine per cent. injured by curculio.

1923. Headlee, T. J. *Ibid.*, Report for 1922, p. 373. Table showing comparison of dust and spray on apples including curculio records. Dusts do not control curculio as well as sprays.

1924. Headlee, T. J. Ibid., Report for 1923, pp. 276-278, Tables 6, 7 and 8. Results of curculio spraying.

1925. Herrick, Glenn W. In Manual of Injurious Insects, pp. 156-157. "*Control measures.*—All fence rows, hedge rows, and stone walls should be removed from about an orchard. Sunlight on the fallen fruit is fatal to the larvae within, hence judicious pruning to let in the light is useful. Cultivation during late July and early August will destroy pupae in the soil. Thorough spraying with arsenate of lead two pounds to one hundred gallons of water just after the petals fall and again ten days later will be effective if the hibernating places have been destroyed."

1918. Pickett, B. S., Watkins, O. S., Rüth, W. A., and Gunderson, A. J. Illinois Agricultural Experiment Station, Bulletin 206. Contains much valuable information on orchard sprays for the curculio and their results are ably discussed in tables and text. Page 492, under General Summary: "Codling moth and curculio, as a rule, were well controlled by applications of arsenate of lead." Page 493, controls obtained "from 60 to 94 per cent. (in the most successful experiments in 1913) and the least effectively sprayed plats from 32 to 79 per cent. In 1914 the most effectively sprayed plats showed controls ranging from 81 to 97 per cent. and the least effectively sprayed plats from 45 to 87 per cent. In no case did spraying with arsenate of lead fail to exercise a decidedly beneficial effect."

1912. Quaintance, A. L. and Jenne, E. L. U. S. Department of Agriculture Bulletin No. 103. The most extensive single publication on the plum curculio and its control yet published. Contains summaries of all previous work data on life history and parasites and accurate studies of control measures. Page 200 under conclusions: "With a small amount of fruit and abundance of curculios the most thorough spraying will not serve to bring through a satisfactory amount of sound fruit"—"with a large crop of fruit and abundance of insects, results will likewise be disappointing." Recommends four sprays for apples using dilute fungicide and lead arsenate: (1) as cluster buds are out; (2) as petals fall; (3) three or four weeks after petals fall; (4) nine or ten weeks after petals fall. Secured controls amounting to from 19 to 77 per cent. increase in sound fruit from sprays tested. The best figures show 91.07 per cent. sound fruit as a maximum obtained by the method advocated.

1922. Quaintance, A. L. and Siegler, E. H. U. S. Department of Agriculture, Farmers' Bulletin 1270, pp. 7-10. "Most practical means of control are spraying with arsenate of lead, and cleaning up of trash from the orchards and vicinity as well as through cultivation during the summer—the prompt collection and destruction of infested fallen fruit will also aid in reducing this pest." The first spray application to poison the beetles should be applied in pink cluster bud stage, and the second as soon as the petals have dropped, using arsenate of lead at the rate of 1 pound of powder or 2 pounds of paste to 50 gallons of water or fungicide. Supplemental treatments are desirable in orchards where the curculio is more than ordinarily destructive.

1914. Singerland, M. V. and Crosby, C. R. Manual of Fruit Insects, pp. 243-251. Recommends for apples: two sprays as for codling moth just after petals fall and three weeks later—"but where the infestation is severe additional applications will be found necessary." Thoroughness of spraying is essential. Reliance should not be placed on any one method of attack. Clean cultivation, proper pruning, thorough cultivation at proper time are necessary.

1922. Snapp, O. I., Turner, William F., Roberts, J. W. U. S. Department of Agriculture Circular 216. Decribes methods used for controlling curculio in the Georgia fruit belt. Recommends destruction of early drops or disking to destroy pupae, and proper orchard sanitation. Jarring the trees also mentioned.

1924. Snapp, O. I., and Alden, C. H. U. S. Department of Agriculture, Bulletin 1205. Dusting and spraying peach trees after harvest for control of the plum curculio. General summary, p. 17: "Post-harvest treatments are not advisable except in cases where the curculio infestation has been severe during the peach season." Two applications of 10 per cent. lead arsenate and 90 per cent. hydrated lime dust are recommended for these treatments.

TESTS OF ALCOHOL-FORMALIN FOR CONTROL OF AMERICAN FOUL BROOD IN BEES

PHILIP GARMAN

Several combs containing American foul brood were received from two different sources in 1925, and treated with Hutzelman's solution or various modifications thereof, with the following results:

1. Comb received May 28 and examined carefully; gross characters were positive for American foul brood; microscopical examination positive; cultures made on egg-yolk agar—apparently positive in manner of growth and morphology of the organism. Treated with homemade Hutzelman's solution containing one-half gallon formaldehyde (40 per cent.) and two gallons of alcohol (completely denatured formula number 5). The comb was placed in a small three frame hive. It was examined August 4 by Inspectors Yates and Coley and no disease was found. The combs continued clean throughout the summer and on September 24 a full sheet of brood had been formed. There was no evidence of the disease or injury from the treatment.

2. A comb received May 28; gross characters positive; microscopical picture and cultural features positive. Treated with formaldehyde (40 per cent.), one-half gallon, and water two gallons. A full sheet of brood was allowed to develop and the colony dequeened. No sign of the disease was seen and no scales could be found after brood was out. Examined August 4 by our inspectors; no disease found.

3. Comb from same source as Nos. 1 and 2; gross characters, microscopical picture, and cultural features positive. Treated with Hutzelman's solution, commercial product. Continued brood rearing throughout the summer, the comb being examined

August 4, and found free of disease; comb continued clean throughout the summer and examination September 24 showed no disease.

4. Comb received June 19, from another source—fairly rotten with American foul brood. Gross characters and microscopical picture positive. Cultures not made. Comb treated with commercial Hutzelman's solution without uncapping brood, but after extracting honey. Soaked 48 hours; examined September 24, and no diseased brood was found.

Combs treated in 1924 were kept under observation and no signs of American foul brood developed. Two combs treated with homemade Hutzelman's solution in 1924 the same as No. 1, above, were found to be freely used by the bees for brood rearing and storing honey. One other comb, however, treated with paraformaldehyde, the latter being left in the comb, remained throughout the season without brood and with very little honey. Although placed in a very strong colony, the bees seemed to ignore this comb and would have nothing to do with it. It apparently retained enough paraformaldehyde to be objectionable, although it had no deleterious effect upon the colony as a whole.

Several other combs were treated by similar methods but results so far have been similar to those already described and no description of them will be attempted.

THE PEAR PSYLLA IN CONNECTICUT

Psylla pyricola Forster

PHILIP GARMAN

By far the most important enemy of pears to-day in Connecticut is the pear psylla. It is reported to have been introduced into this State from Europe about 1832 and is now found throughout the northeastern United States. Much and serious damage may result from an infestation, the leaves becoming stunted and black or sooty, many dropping prematurely. The fruit may become discolored and remain undersize and the fruit buds may be affected, resulting in a decreased yield the following year. Pear psyllas are present in many Connecticut orchards and cause considerable damage every year.

Life History: The winter is passed in the adult stage, the insects hiding under the bark usually near the ground, but also in other places. They emerge during warm days in spring and lay their eggs on growing shoots. According to published records, the eggs hatch in 12 to 18 days and the nymphs mature in about a month. Eggs of the second brood hatch in about 12 days and there are reported to be three or four broods in New York State (Hartzell). The separate broods are completed in about a month and a half.

The Different Stages: The egg is a small yellow pyriform object about one-eightieth of an inch in length, and under proper magnification may be seen to possess a short stalk at the larger end and a small thread at the other. The nymph is very much flattened, with very large rounded wing pads, and is able to secrete quantities of honey-dew in the early stages. There are reported to be five immature nymphal stages, the first three of which secrete honey-dew in which grows a black sooty mold responsible for the disgusting appearance of trees that are heavily infested.

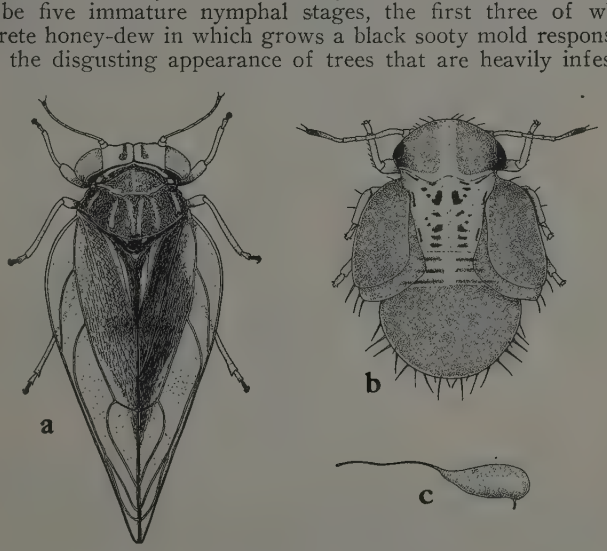

FIG. 43.—The Pear Psylla, *Psylla pyricola*. a. adult; b. nymph; c. egg. Enlarged about 25 times.

The adult is a small winged insect somewhat resembling a small fly or gnat when on the wing, but when magnified resembling a cicada in miniature. The egg, nymph and adult are shown in Figure 43, and egg on Plate XX, a.

Biology and Control Measures: In controlling the pest there are several points to be considered. First: the nymphs do not hibernate until late fall and they emerge very early in the spring, after a few days of warm weather. Headlee states that they may be found frequently in cool weather clinging to the smaller twigs "too stiff to move" and a spray with miscible oils or soaps and nicotine at this time should be very effective. The same condition exists in the spring after the insects have emerged from hibernation, which condition affords an opportunity to finish the spray, if not completed in the fall. The second point to be kept in mind is that the insects continue to lay eggs well up until the

cluster buds of most varieties begin to separate and in some cases even longer—so that dormant sprays must be delayed as long as possible at this period in order to kill the greatest number. Thoroughness at this time is very essential. Even these sprays, however, (the dormant with miscible oil or soap and nicotine, and the delayed dormant egg spray of lime-sulphur at the cluster bud stage) may not kill a sufficient number to protect the orchard throughout the summer and other treatments must usually be considered if commercial control is secured. One of the most successful summer sprays developed thus far is the Bordeaux-nicotine-sulphate (Hartzell) spray applied at the calyx or petal fall

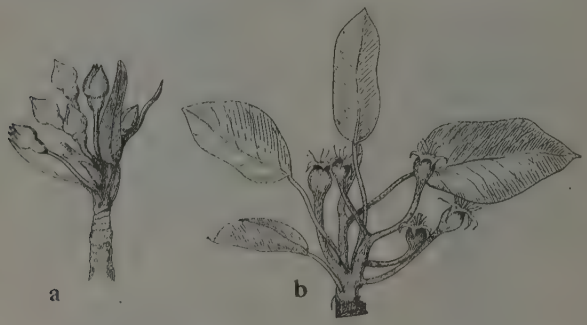

FIG. 44.—a. Pear blossom buds at proper stage for delayed dormant spray of lime-sulphur 1 to 8. b. Time for first application of heavy lime bordeaux or heavy lime-dry-mix.

period and often repeated in July. This spray has a decided effect in checking the development of the nymphs and has been used successfully in some Connecticut orchards. Others make use of a self-boiled lime-sulphur or dry mix formula with added nicotine, since pears usually need some form of fungicide to check scab or other diseases. It is very generally recognized, however, that commercial lime-sulphur is liable to burn the foliage severely if used as a summer spray. In general, considering work done in neighboring States, the following spray program for Connecticut is suggested as one likely to give the best results.

(1) In fall or spring when the temperature is above freezing and adult psylla are found on the twigs "too stiff to move,"—miscible oil 1 to 15, or nicotine sulphate 1 pint in 100 gallons with 4 pounds of soap added.

(2) When the blossom buds begin to separate in the cluster,—lime-sulphur (commercial 33° Be) 1 part in 8 parts of water. (See Figure 44, a.)

(3) At the calyx or petal fall period soon after the blossoms have fallen,—Bordeaux-nicotine-sulphate mixture composed of 2 pounds of copper sulphate, 40 pounds hydrated lime, and 1 pint of nicotine sulphate in 100 gallons of water; or dry mix consisting of superfine sulphur, 16 pounds, hydrated lime 8 pounds, and calcium caseinate 1 pound. The dry mix is first mixed with a small amount of water in the spray tank, 1 pint nicotine sulphate and 32 pounds hydrated lime are added, and the whole made up to 100 gallons. (See Figure 44, b.)

(4) Same as No. 3, to be repeated in July if the nymphs become numerous.

Some growers maintain that after control is once secured and the insects are reduced in numbers sufficiently, the winter spray can be safely omitted. In cases of severe infestations all sprays should be employed and great thoroughness exercised in making the applications.

Much experimental work has been done with control of adult psylla by means of nicotine and cyanide dusts. While not yet studied sufficiently to make definite statements regarding them, it seems probable that they will become useful weapons in the hands of the grower.

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Herrick, Glenn W. In Injurious Insects, pp. 145-146.

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OUTBREAK OF PEA APHID ON ALFALFA

B. H. Walden

One of the unusual insect problems in Connecticut during 1925 was the injury caused to alfalfa by aphids. On May 13, Mr. Raymond K. Clapp, Agent of the New Haven County Farm Bureau, called at the Department to obtain information regarding the control of aphids on alfalfa, stating that a field in Seymour belonging to Mr. Elmer R. Meade was badly infested and that many of the plants were turning yellow.

As this was the first time that our attention had been called to

insect injury to alfalfa, a visit was made to the field on May 14. Fully half an acre near the center of a three-acre field was badly infested with large green aphids. Some of the plants, though still green, had the leaves curled and the growth was apparently checked; others had turned yellow and many were completely dried up; even the crown appeared to be dead. Many aphids were found throughout the remainder of the field, though the plants had not been seriously injured.

The identity of the species could not be determined in the field and material was collected and brought to the laboratory for study. It was suspected, however, that this was the pea aphid, which is known to live part of the season on various clovers, often causing considerable damage, and which has been taken on alfalfa, although according to Davis* the pea aphid was not formerly considered a serious pest of alfalfa. It was later found upon examining the insects under the microscope that this was the pea aphid, *Illinoia pisi* Kalt.

During the warm part of the previous day, Mr. Meade dusted a small section of the field with 2.7 per cent. nicotine dust, applied with a hand duster. The plants still showed a good coating of dust and there were many dead aphids on the ground, but there appeared to be about as many live ones on the plants, indicating that it would take more than one treatment to control the aphids. It was evident that it would not be practicable to treat the whole field with a hand duster, and Mr. Meade questioned whether the value of the crop would warrant two applications of dust, using a power duster.

Normally the alfalfa would not be cut for two or three weeks, but it was suggested that if the aphids remained on the plants and the injury increased, it would be well to cut it early, as the cutting and curing of the hay would kill many of the aphids and expose the survivors to the direct sunlight. A number of aphids that had been parasitized were observed. Lady beetle larvae and Syrphid larvae were present in limited numbers. No aphids which had been attacked by fungus were observed at that time.

On May 15, another field of alfalfa belonging to Doody Brothers of North Branford was examined. About one acre of three or four year old alfalfa was found to be infested with the pea aphid. Occasional plants were turning yellow, but the injury was not as severe as at Seymour. This field had suffered from drought the previous fall and the plants had not made a thrifty growth.

Some of the aphids were parasitized and many of them had been killed by a fungus, probably *Empusa aphidis*.

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* The Pea Aphis with Relation to Forage Crops, J. J. Davis, U. S. Department of Agriculture Bulletin 276, 1915.

Adjoining this piece of alfalfa was a five-acre field of younger plants. Many aphids were present near the margin next to the older field but the plants were more vigorous and showed very little injury. A second visit was made to the field on May 19. The condition of the plants appeared to be about the same as on May 15, but more than one-half of the aphids had been killed by the fungus. On May 28, the injury to the plants had not materially increased. Another generation of aphids was present and though the fungus did not seem to be increasing, a larger proportion of the aphids had been attacked by Hymenopterous parasites. The infestation had extended further into the younger field of alfalfa, but these plants did not as yet show any serious injury.

Reports of injury to alfalfa on three farms in Hartford County were received from Mr. B. G. Southwick, County Agent. These infestations were investigated on May 20. A field in East Windsor of about one acre owned by Mr. H. F. Barber was injured by drought during 1924 and came through the winter in poor shape. After the plants were found to be infested with aphids, the owner plowed the alfalfa under in order to use the land for some other crop.

About two acres of alfalfa belonging to Mr. G. A. Stoddard of West Simsbury were noticeably injured towards one end of the field where there was a pocket or depression in the surface of the field which may have held water and caused more or less winter injury to the crop. While aphids had been present over the whole field there were very few alive on May 20. A large percentage had been killed by fungus. Mr. Stoddard considered that the injury was practically over.

Mr. O. D. Fuller, a neighbor of Mr. Stoddard, owned the field where the third infestation was reported by Mr. Southwick. This was not seen by the writer, but Mr. Fuller stated that the conditions were similar, though the injury was somewhat less than in Mr. Stoddard's field.

Specimens of the pea aphid on alfalfa were brought into the office from Middletown on May 23. There were many specimens on the stems and leaves, but a large proportion of them had been attacked by the fungus.

Another report of aphids on alfalfa was received from Woodbridge but this infestation was not examined.

From observations made in these fields, it was quite evident that the plants most seriously injured by the aphids were those which had been weakened either by drought or winter injury. Many of the most vigorously growing plants, though badly infested with aphids, did not appear to be noticeably checked. It has also been observed that thrifty fields of red clover can stand comparatively heavy infestations without showing noticeable

injury. It is impossible to predict whether or not the pea aphid will injure alfalfa again in 1926.

According to Davis, (l. c.) the pea aphid was introduced from Europe and reported as occurring in this country in 1878-79, although the first report of serious injury to peas was some 20 yeas later, in 1899. In 1907, the species was collected on alfalfa in Arkansas, but as late as 1915, Davis states that *M. sativa* (alfalfa) is not universally and commonly attacked by the pea aphid.

In 1921, however, the pea aphid was reported as injuring alfalfa in Colorado, Kansas, Missouri, Nebraska, Oklahoma, and Oregon.* In 1923 it was reported as infesting alfalfa in 12 states, and during the past season it was reported from six states besides Connecticut.

The pea aphid in the north passes the winter as small shiny black eggs on the stems of clovers. The eggs hatch early in spring and there are about 12 generations during the season. Some of the individuals usually remain on clover throughout the year. In years when they are abundant, about July 1 in Connecticut, the majority of the aphids migrate to peas.

The pea aphid has an unusually large number of natural enemies. The most important natural check is probably the aphid fungus *Empusa aphidis*. This was very abundant in the alfalfa fields in North Branford and West Simsbury and the specimens from Middletown showed many individuals which were infested with this disease. The appearance of aphids attacked by this fungus is shown on Plate XVIII. Many lady beetle larvae and larvae of Syrphid flies were feeding on the aphids in the various fields. Aphids that had been attacked by Hymenopterous parasites as shown on Plate XVII, b, were found in all the fields examined. Three species of these parasites were reared, and later determined by the U. S. Bureau of Entomology, as *Aphidius rosae* Haliday, *Megorismus fletcheri* Crawford and *Lygocerus niger* Howard. The first mentioned species was by far the most abundant.

INJURY TO APPLES BY THE RED BANDED LEAF-ROLLER AND ITS CONTROL

B. H. Walden

Injury to apples similar to that shown in Figure 45 has been frequent in Connecticut orchards during the past few years and is due to the work of the red banded leaf-roller, *Eulia velutinana* Walker, which feeds at the surface of the fruit. The injury is apparent at picking when the greenish larvae are often found at

* Insect Pest Survey Bulletin, Vol. 1, 3, 4, 1921-1924.

work beneath where a leaf had rested against the fruit or where two apples have touched when on the tree. The larvae also readily attack the fruit where there is no protection, working beneath a thin whitish web secreted by the larvae. The injury is frequently on the side of the apple, and the growers often call the trouble "side worm injury." The larvae, however, readily feed around the calyx and occasionally around the stem. Fruit thus injured gives trouble in storage since the injury occurring late in the season does not heal over and affords an entrance for rot-producing organisms.

FIG. 45.—Work of red banded leaf-roller on fruit, natural size.

If any of the larvae are present on the fruit when stored, the injured area is often increased by further feeding, or the larvae may leave these apples and attack sound fruit.

Several other insects cause somewhat similar injuries on the surface of the fruit, but these can usually be distinguished from that of the red banded leaf-roller. The work of the lesser apple worm is often confused with that of this insect. The injury may be much the same shape but the lesser apple worm does not eat the skin of the fruit, but mines just beneath and when partly grown may tunnel into the core, while larvae of the red banded leaf-roller readily eat the skin and the injury is confined to the surface of the fruit.

Second brood codling moth larvae may feed on the surface but

eat much smaller areas and soon tunnel into the fruit. The larvae of the red banded leaf-roller are light green in color with yellowish-brown heads, while the larvae of the codling moth and lesser apple worm are of a white or pinkish color with much darker brown heads.

The life history of the red banded leaf-roller has not been carefully worked out for Connecticut, but will probably be similar to the observations made in Pennsylvania,* where it has been found that this insect passes the winter in the pupa stage. Adults emerged in the spring and were most abundant in the orchard from May 4 to May 16. Eggs deposited on the branches May 11 hatched on May 18, and larvae were present in the orchard from that date until November 1.

Observations have been made on the control of injury from this insect in our dusting and spraying experiments at Milford Data collected in 1922 is given in Table I. The formulas used were as follows:

SPRAY

Commercial lime-sulphur ..	3 gallons
Lead arsenate (dry)	3 pounds
Nicotine sulphate	¾ pint
Water	100 gallons

DUST

Dusting sulphur	65 per cent.
Lead arsenate	10 per cent.
Nicotine sulphate	5 per cent.
Carrier	20 per cent.

TABLE I.

Plot	Treatment	Total Number of Apples	Per cent. of Injury by *Eulia*
1.	5 sprays, April 19, May 22, June 14, June 30, July 20	6,760	.32
2.	3 sprays, April 19, May 22, June 14	6,072	.69
3.	5 dust, April 19, May 22, June 14, June 30, July 20	4,881	.74
4.	3 dust, April 19, May 22, June 14 ..	3,137	.92
5.	Check	1,673	5.47

All plots shown in the table received three applications as follows: April 19, May 22 and June 14; while plots 1 and 3 received two extra applications on June 30 and July 20.

* Pennsylvania Agricultural Experiment Station Bulletin 169, p. 11, 1921.

Though the figures are not striking, the sprays were somewhat more effective than the dust treatments and where five sprays were given, the injury was reduced about one-half over three applications.

The results obtained in 1925 in the Milford orchard with spray in comparison with dust and combination spray and dust treatments are given in Table II. The following formulas were used:

SPRAY FORMULA

Lime-sulphur (dry)	6 pounds
Lead arsenate (dry)	3 pounds
Kayso	1 pound
Water	100 gallons

DUST FORMULA

Dusting sulphur	90 pounds
Lead arsenate	10 pounds

TABLE II.

Plot	Treatment	Total Number of Apples	Per cent. marked by *Eulia*
1.	Spray with Kayso, May 1, May 19, June 2-3, July 1, July 26	6,424	.3
2.	Spray without Kayso, same dates as above	3,600	.4
3.	90-10 sulphur-arsenate dust, May 1, May 19, June 2-3, July 1, July 26 ...	4,293	1.7
4.	4 dust applications between May 1 and July 1. 1 spray, July 26	5,285	.5
5.	Spray, May 1; Dust, May 19; Spray June 2-3; Dust, July 1; Spray, July 26	1,959	.5
6.	Spray, May 1, May 19; Dust, June 2-3, July 1, July 26	7,005	1.1
7.	Check, no treatment	2,250	11.2

Although all treatments gave fairly good control, the sprays (plots 1 and 2) gave the best control and the combination treatments with late sprays (plots 4 and 5) were next.

It is evident that if the red banded leaf-roller continues to be prevalent in certain seasons, that it will be necessary to spray apple orchards later than has been the general practice. In case the apple maggot and the apple and thorn skeletonizer are present, the same treatment should help control them.

THE RASPBERRY FRUIT WORM, BYTURUS UNICOLOR SAY, INJURING STRAWBERRY BLOSSOMS

B. H. Walden

On May 22, a visit was made by request to the fruit farm of Mr. C. Bussa at South Glastonbury, to examine some strawberries which were being injured by beetles feeding upon the blossoms. On several rows of Stevens, a late variety which was just beginning to bloom, adults of the raspberry fruit worm, *Byturus unicolor* Say, were feeding on the petals and centers of the blossoms as shown on Plate IX, a.

The plants on the opposite side of the field were uninjured, although there was a block of red raspberries a short distance beyond. As there were no raspberries near the infested side of the strawberry field, the situation was rather puzzling until the owner explained that there had been a badly infested raspberry field on this side which was removed in the spring. A large number of the beetles had evidently wintered in the soil and upon coming out in the spring were forced to feed upon the strawberries, in the absence of their natural food plant.

As there were only a small proportion of the strawberry blossoms open and no honey bees observed in the field, it was suggested that spraying at once with lead arsenate might help to check further injury.

The field was examined again on June 5. Though the owner had not sprayed the plants, the beetles had nearly all disappeared. No eggs were found on the strawberries, although beetles and eggs were present at this time on the raspberry plants.

The injury to the strawberries was probably less than it would have been to an earlier variety. There were a few less berries set on these rows than on the uninfested ones, and some of the first set fruit was deformed. The fact that there were fewer berries at the first picking would give the later berries a chance to grow larger than if there had been a full crop, so that it was hard to estimate the actual damage by the beetles. It probably did not exceed 10 per cent.

This is the first time that raspberry beetles have been observed feeding on strawberries in Connecticut and it was undoubtedly due to the removal of the adjoining raspberry field. There will probably be little or no damage to the strawberries next season as there were no indications that the raspberry beetles would develop on strawberries.

THE EUROPEAN CORN BORER IN CONNECTICUT

Pyrausta nubilalis Hubner

M. P. Zappe

This destructive insect was first discovered in Connecticut late in the fall of 1923. At this time Federal scouts found three small separate infestations along the shore region of Connecticut in the eastern part of the State, two in the town of Groton, and one in Niantic in the town of East Lyme. These were cleaned up and most of the infested material burned in the fall of 1923, the work being finished in the spring of 1924. No larvae of the European corn borer were found at these infestations the following year.

During the summer and fall of 1924, seven separate infestations of this insect were found in six shore towns of Connecticut by Federal scouts, in the following locations: Bridgeport, in a corn field at Hillside Home in the northeastern portion of the city; New Haven, at Granniss Corner, infestation in small gardens; Old Lyme, in a small corn field on the eastern side of the town; East Lyme, in a large field of corn near Crescent Beach; Groton, in a small corn field about one mile north of the Town Hall; Stonington, two infestations in small gardens in the village of Mystic.

Clean-up work began on December 1, and was completed December 12. This consisted of burning all corn and weed stems in the infestations and in surrounding fields and gardens. A total of 5,485 gallons of fuel oil was burned. An account of this clean-up work may be found in the Report of this Station for 1924, page 277.

In the summer of 1925, the scouting covered all the shore towns of Connecticut and also included the town of Orange and a part of the town of Woodbridge, which, together with Milford, forms an area where quantities of seed corn are grown and it was deemed advisable to have this area examined. All scouting in 1925 was done by Federal scouts, but the State of Connecticut co-operated by paying one-half of the wages of these men while scouting within the State. Besides the infestations of European corn borer found, 509 larvae were sent to the Federal laboratory at Arlington, Mass., and identified as not being the European corn borer.

Infestations of 1925

The scouting work of 1925 revealed the presence of the European corn borer in 20 separate infestations in the following five towns: Bridgeport, Saybrook, New London, Groton and Stonington. Nothing was found around the last year's infestations in New Haven, Old Lyme and East Lyme, these points being entirely free from any infestation.

Bridgeport Infestation

An infestation was found at Hillside Home near last year's infestation where European corn borer larvae were found in stems of smartweed in 1924. The clean-up work last year was not entirely satisfactory. The Superintendent of the Home promised to assist by having his men throw corn stalks, stubble and weeds into piles to make the burning easier. The men doing the work tried to plow out the stubble and as a result, some of it was left just below the surface of the ground where the larvae were safe from the fire.

This season the Superintendent had the corn fields plowed, the work being supervised by Federal men who followed the plow and threw all stubble and corn stalks into the furrow where the plow could cover it deeply on its next trip. This proved satisfactory and most of the material was well covered. After plowing, every bit of stubble, corn stalks or weeds that could be found above ground was collected into piles and burned. All weed areas within a reasonable distance of the infested fields and all weeds around fences, barns, and in a dump nearby were burned. Five entire days were spent in actual burning at this infestation by a force of 10 men, besides parts of several other days spent on clean-up work preparatory to burning. In all, 428,475 square feet of land was burned over, and 5,670 gallons of fuel oil were used. The work was finished on December 11, 1925.

Saybrook Infestation

This infestation was found in sweet corn growing in a garden just west of Oyster River on the State road betwen New Haven and New London. Part of one day was spent in clean-up work before burning. Eight men spent part of one day in burning, using about 300 gallons of fuel oil. About 10,800 square feet of ground was burned over, but operations at this infestation are not completed, as there are still two nearby gardens to be covered. We hope to finish work here early in the spring of 1926.

New London Infestation

This infestation was situated in the northern part of New London just inside the city limits. It was found in a large field of field corn owned by Mr. J. J. Higgins. This was a heavy infestation, 18 larvae being found in a very short time, all of which proved to be the European corn borer. There were no other fields of corn near the infested field and only a few small gardens, some of which had corn stalks in them. These were all included in the burning program. About 60 large shocks of corn were burned, as well as all stubble which had previously been dug out of the ground and soil removed from the roots. Weeds

and trash around the infested field, and other material which might harbor the larvae were burned in about eight nearby gardens. Two men spent two days in preparatory work and 11 men spent two whole days burning up this material. A total of 1,789 gallons of oil was consumed here, burning over an area of about 256,200 square feet. Work was completed on December 15, 1925.

Groton Infestations

In the town of Groton, a total of eight infestations was found. Two of these were in the borough of Groton, one at 50 Pleasant Street, west of the house of George Hempstead, where two larvae were collected in sweet corn; the other was at 97 Baker Avenue, in the garden of Mrs. J. E. Lamb, where a total of 10 larvae were collected in a small patch of sweet corn.

The preparatory work was done by five men working for two days on both infestations. These two infestations, being in the borough where nearly everyone has a garden, several adjoining gardens on both sides of each street were also cleaned up and burned. This required the time of 11 men for two and one-half days, it being necessary to burn over 172,855 square feet of land, using 1,921 gallons of fuel oil. Work on these two infestations was completed on December 18.

Owing to the fact that these infestations were in a thickly populated section of the town and that there was danger of setting fire to some of the many out-houses, chicken coops, fences, etc., it was thought advisable to have some fire-fighting apparatus immediately available if needed. One of the gipsy moth power sprayers was sent down from the State storehouse at Danielson, the tank filled with water, hose coupled together, and ready for use if occasion should require it.

In the section of Groton known as Noank, there were five separate infestations. Two of these were on Spicer Avenue, where 19 larvae were collected in sweet corn in small gardens; another was on Shore Street, where seven larvae were collected in sweet corn in a small back-yard garden. Another one was found in a good sized patch of sweet corn near the corner of Main and Church Streets, where 14 larvae were dug out of sweet corn.

An infestation was also found on Brook Street, Noank, where one larva and one pupa were found. Several corn stalks were found that showed the work of the European corn borer, but the larvae had pupated.

Some of the preliminary work has been done at the Noank infestations, but no actual burning has taken place on account of the area becoming covered with snow and ice. This area will have to be left until spring before it can be burned.

Two other infestations found in the town of Groton are located just at the western edge of the village of Mystic on what is known

as Baptist Hill on the State road to New London. These were both in back-yard gardens, where a total of 12 larvae were found in sweet corn. These infestations have been prepared for burning but no actual burning has been done. Many adjoining gardens have also been cleaned and material in them will be burned this coming spring.

Still another infestation in Groton occurs in the garden of Mr. J. M. Whitman at 13 Grove Avenue, Mystic, where two larvae of the European corn borer were found. No control work has been done at this infestation but we expect to complete the clean-up work in the spring before the moths can emerge.

Stonington Infestations

In the town of Stonington five widely separated localities were found infested extending from the very eastern boundary of the town to the western edge in the village of Mystic. One was found in Pawcatuck, another at Lord's Hill, another on Pequotsepos road, still another on the Old Mystic road, while the infestation of several small back-yards on the Stonington side of Mystic may be considered to be the fifth. The latter infestation really consists of three small infestations near enough together to be considered as one infestation. They are all located within a few blocks of each other on the east bank of the Mystic river north of the main street in Mystic. No clean-up work nor burning has been done here yet, but we expect to burn this coming spring all material which may harbor larvae of the European corn borer.

In 1924, there were two infestations in this neighborhood, and it is quite probable that more existed, that were not discovered and adults from these may have been responsible for the reinfestation. The work to be done here must necessarily cover quite a large area of ground in order to be sure that all infestations found have been burned as well as covering some additional land for a margin of safety.

Only one infestation in Stonington has been burned. This is situated on the Mystic-Old Mystic road, east of the river, where 20 larvae and 11 pupae were collected in a large patch of sweet corn. Mr. Edward A. Smith, the owner of the farm, grew sweet corn and cut flowers to sell to people who were summering at Groton Long Point. All corn sold and removed from this farm was inspected by Federal men, to prevent any possible spread from this infestation.

All corn, weed and flower stalks here were burned, as well as the corn stalks on the adjoining farm. It took 11 men four days to burn over 58,400 square feet of ground, using about 1,587 gallons of fuel oil.

Another infestation was found about one mile east of the Smith farm on the Pequotsepos road on land belonging to Mr. H. Wilcox. This was in a small patch of field corn and only three larvae were

found. The owner was allowed to feed the corn stalks to his cattle with the understanding that he would burn all stalks which the animals did not eat.

The stubble was dug and thrown on a pile of wood brush, etc., and though not yet burned, it will be very early in the spring and without oil if possible. As this infestation was quite distant from any other corn fields, it was not thought necessary to do any burning outside of the infestation itself. However, the owners of the adjoining farms promised to burn in the spring all corn stalks which the cows had not eaten during the winter.

About two miles west of Stonington village on the farm of James Lord at Lord's Hill, another infestation was found. This was in a large garden patch of sweet corn. Mr. Lord has been permitted to feed corn stalks from the infested fields to his cows, provided that he burns up all stalks left uneaten.

The corn stubble has all been dug from the ground and thrown into small heaps. A perennial garden just over the fence from the infested fields has also received attention; all flower stalks and weeds have been cut, raked and thrown over the fence into the corn field. An adjoining field of corn planted for ensilage and abandoned, contains much grass and weeds, which will also be burned in the spring when weather permits burning operations.

One infestation is located in lower Pawcatuck on land owned by Mr. W. E. Miner, where seven larvae were collected from a large patch of sweet corn. This corn patch is close to the Pawcatuck river, which is the boundary line between Rhode Island and Connecticut, and seems to be an isolated infestation, as the nearest known infestation is about five miles to the west.

The Pawcatuck infestation has been prepared for burning. The owner attempted to burn the corn stalks in the infested field, but was not entirely successful. These partially burned corn stalks have been gathered and weeds and grass cut off and raked away from fences and buildings preparatory to burning in the spring.

Extension Work

Before any actual clean-up work was started, it was thought advisable to enlist the co-operation of the householders near the infestations and ask them to clean their own yards and gardens by burning weeds, corn stalks, etc. If they could be induced to take care of their own yards, it would mean a considerable saving of work and expense for the State, as well as to reduce the chances of missing any undiscovered borers in material around the present known infestations. The territory which the State could clean up would necessarily be limited to a few yards surrounding each infestation.

A house-to-house canvass was made, in a one mile radius around each of the infestations. Three men spent seven days on this work.

To save time in explaining to the householders what they were requested to do, the following notice was either given to each one or left at the door.

EUROPEAN CORN BORER HERE

Will You Co-operate?

Some of you may have seen men looking over your corn and other crops. These men were hunting for the European Corn Borer, a very destructive pest from Europe now occurring in Eastern New England and around Lake Erie.

This pest has recently been found in small numbers in your vicinity. There is grave danger that it may soon spread throughout the State. Every reasonable measure is being used to control it, but you can help.

All cornstalks should be destroyed:—if fed to cows, the thick stalks which the cows do not eat should be burned. All large weeds, dahlia stalks, and other flower stalks should likewise be burned.

Please cut your stalks off close to the ground and not leave stubble five or six inches high. Some of the borers may be in the stubble, and digging and burning the stubble is expensive. When cut off at the surface of the ground, the borers are all in the tops. A sharpened hoe is an effective tool for cutting the stalks.

The scouting and control work is done by the Federal Bureau of Entomology and the State Entomologist of Connecticut in co-operation.

Further information regarding the pest may be obtained from

W. E. Britton, State Entomologist,
P. O. Box 1106, New Haven, Conn.

This work was done early in October. At the time the burning work was finished in the latter part of December, only one householder had completely cleaned up all material which might harbor larvae of the European corn borer. Several others had attempted to burn their corn stalks, but only the leaves and tassels had been consumed. The most important parts of the corn, the thick stalks, had not been burned at all. Perhaps early in the spring, when the material is drier, the gardeners will have more success.

In Mystic and Noank, many people were in the habit of throwing old stalks, rubbish, etc., into the river. We tried to discourage this practice, as the material would only drift ashore and, if infested, might start other infestations perhaps miles away from the origin of the material.

Summary of 1925 Work

Number of towns scouted	25
Number of towns infested	5
Number of infestations found	20
Number of square feet of land burned over	926,730
Gallons of fuel oil used	11,267
Amount of money spent by State	$4,739.63

FURTHER NOTES ON THE ASIATIC BEETLE

Anomala orientalis Waterhouse

W. E. Britton and M. P. Zappe

This introduced insect pest has been discussed in preceding Reports of this Station as follows: 1922, page 345; 1923, page 291; 1924, page 294. Bulletin of Immediate Information, No. 52, issued December 15, 1925, and entitled "A New Pest of Lawns,"

Fig. 46.—Map of Westville showing the portion infested by the Asiatic beetle, surrounded by black line.

also deals with this insect, and brief notes were published in the Journal of Economic Entomology, Vol. 15, page 311, and Vol. 17, page 309.

During the first half of the summer of 1925, this insect seemed to cause little damage, and very few inquiries and complaints were received regarding it. At a brief talk in Washington, D. C.,

July 28, 1925, before the summer field meeting of the Northeastern Entomologists, the senior author made statements to this effect. In fact, at that time it seemed to him that the insect was not increasing, that the injury was no worse than in 1924, and that it had spread only slightly. But later in the season he felt like telling a different story. During August and September, many inquiries and reports of injury were received at the Station. In passing through the streets of the infested region, more injured lawns were noticeable than have ever been seen before since the presence of this pest was discovered in New Haven. Figure 46

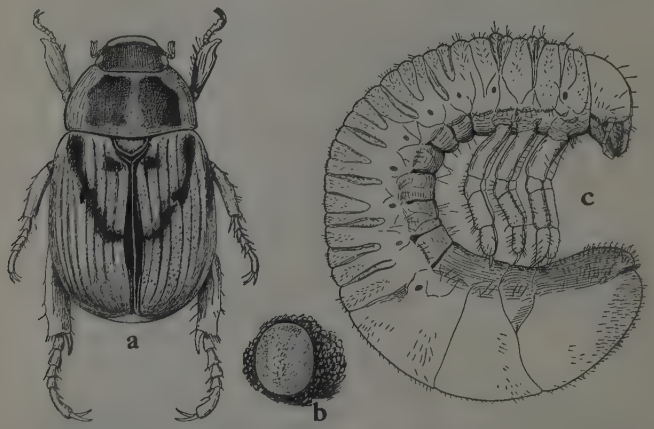


FIG. 47.—The Asiatic beetle, *Anomala orientalis*. a. adult beetle. b. egg. c. grub or larva. All enlarged about five times.

shows the area where the infestation occurs, and Figure 47 shows the appearance of the beetle, larva and egg. Plate XI, b, shows injury to lawns.

As the injury was more evident and the grubs more numerous than ever before, the matter was reported to the Federal Horticultural Board and the Bureau of Entomology, with a request that specialists be sent to review the situation. Consequently on October 29, 1925, Mr. Loren B. Smith in charge of Japanese beetle investigations, with Messrs. B. R. Leach and J. P. Johnson, all of Riverton, N. J., spent the day in New Haven, and with Director William L. Slate, Jr., and the writers, visited the infested area, observed conditions there, and conversed with residents and property owners. Mr. Smith expressed his opinion that the injury to lawns appeared more serious than similar injury in New Jersey

by the grubs of the Japanese beetle, *Popillia japonica,* which he had ever seen. Also Mr. Smith considered it not only unwise to allow this pest to continue to spread unchecked, but regarded it as a menace to the whole country. Especially if this insect should spread southward, he believed it might prove a very serious pest of various crops.

As a result of this visit, Mr. Smith submitted a report in which he advised an attempt to eradicate the pest by treating the entire area between Chapel Street and Willard Street, Yale Avenue and Forest Street, with carbon disulphide emulsion to kill the grubs. He recommended that the applications be made early next summer, perhaps in May, after the grubs resume feeding near the surface of the ground, and that it be a co-operative project between the Federal Government and the State of Connecticut.

At the time of Mr. Smith's visit, the grubs had descended into the soil for the winter, and consequently did not appear to be nearly as abundant as was the case a few weeks earlier. By digging, however, plenty of grubs were found, most of them being six to eight inches beneath the surface.

Tests and Observations Made in 1925

On April 16, the junior author examined some lawns near the corner of Edgewood and Alden Avenues by cutting out four-inch circles of turf with a sod cutter such as is used on golf greens. Several grubs were found, averaging about one to each circle of turf. Probably most of them had not come up from their winter level in the soil, for an examination later in the season showed the same lawn to have a population of about 40 grubs per square foot.

We still believe that *Anomala orientalis* has an annual generation, though it is evident that some of the grubs do not become mature at the usual time, but continue over into the second season.

Lawns which had been treated with cyanide and reseeded in 1924 were examined on April 16. Some grubs were found here, though the lawns presented a good appearance and no injury was apparent.

On September 25, one square yard of lawn was treated with eight ounces or one-half pound of granular calcium cyanide dissolved in two gallons of water, sprinkled over the surface and washed into the soil with eight gallons of clear water. Five grubs in a wire cage had been buried about two inches deep prior to the treatment. When examined September 30, all grubs were dead but the grass had been injured.

Another section of the same lawn was treated on the same day using calcium cyanide at the rate of four ounces per square yard, or half the amount mentioned above. On September 30, two

square yards were dug up and the grubs counted. One had 39, and the other 44, dead grubs and no living ones were found.

An infested lawn at 39 Elmwood Road was treated with six ounces per square yard of calcium cyanide, late in September. When examined, 24 hours after treatment, there were some living grubs, but several days later, on September 30, all grubs had been killed. This lawn had been spaded prior to treatment and grubs were in the bits of sod that had been turned several inches below the surface.

On October 3, 60 square yards of lawn at 50 Marvel Road were treated with calcium cyanide at the rate of four ounces per square yard. When examined on October 13, no living grubs could be found but the grass had all been killed.

On October 19, four tests were made on grubs in soil buried in cages, with a finer grade of calcium cyanide known as "grade G" or "Cyanogas," using it at the rate of one, two, three and four ounces respectively, per square yard. When examined on October 31, all grubs had been killed and in each case there was slight injury to the grass. Grade G has the same analysis as the granular calcium cyanide but is considerably finer.

Two tests were made with home-made carbon disulphide emulsion; one of 28 square yards, using two fluid ounces per square yard, and the other of eight square yards, using four fluid ounces per square yard. Both applications were made on September 30, and well watered immediately afterward. When examined on October 3, only 2.6 per cent. in the former case and 15 per cent. in the latter case had been killed by the treatment. Emulsions made in this manner are not effective killing agents, but in New Jersey several formulas have been developed which are effective in killing the grubs of the Japanese beetles. One of these provides for emulsifying carbon disulphide with a water-soluble, resin-fish-oil soap, which is said to surround the globules of carbon disulphide and to hold the fumes so that they are given off more slowly and thus act throughout a longer period of time.

At the writing of this paper, plans are under way for carrying out the recommendations of Mr. Smith's report, and the treatment of the infested area, but the funds are not yet assured.

TOBACCO PLANTS SEVERELY INJURED BY WIREWORMS

Mention has already been made on page 227 of severe injury to newly-set tobacco plants in Windsor and other towns in the tobacco growing section of Hartford County. The matter was reported to this office by Dr. P. J. Anderson in charge of the Tobacco Sub-station at Windsor, and Dr. Garman and the writer visited one of the fields on June 2. Most of the damage occurred

to tobacco plants under cloth, but Dr. Anderson reports some wireworm injury to plants in open fields.

One grower had 84 acres under cloth, and on about 40 acres the plants were destroyed and reset. The plants of the second setting were also ruined and the ground set again, and a portion of the third setting had also been destroyed when the writer visited the field on June 2. Many wireworms were collected, 18 being taken around one plant. Adult Elaterid beetles were common, resting upon the cloth both inside and outside the tents. Both wireworms and beetles were identified as *Limonius agonus* Say. After a few days of the extreme heat of the first week in June, the wireworms disappeared so that on June 5, when a second visit was made, it was difficult to find them. Probably they went deeper into the ground to escape the heat, and a few were obtained several inches below the surface. The field was again planted and no further injury resulted.

In some of the fields, about 95 per cent. of the plants were dead when the writer first saw them, and Plate XII, b, shows a view taken at that time. The stems were completely riddled with tunnels, as shown on Plate XII, a.

Mr. B. H. Walden, Assistant Entomologist, identified the wireworms, by comparison with other material, as *Limonius agonus* Say, and this identification was afterwards confirmed by Mr. J. A. Hyslop of the Bureau of Entomology. Specimens of the adult click beetles found resting on the cloth of the tent were also sent to Mr. Hyslop, who reported that these were also *Limonius agonus,* and the adults of the destructive wireworms. The appearance of both adults and larvae is shown in Figure 48. This is not the first record of wireworm injury to tobacco by this species in Connecticut. Our collection contains material from Hockanum in stems of tobacco, June 1, 1920. Mr. Hyslop visited East Windsor Hill, where similar though less extensive injury took place. Mr. Hyslop calls *Limonius agonus* the eastern field wireworm, and it is perhaps the most common species attacking tobacco in Connecticut. It is not the only species, however, as we have material in the Station collection from tobacco and identified by Mr. Hyslop bearing the following records: *Asaphes* sp., Portland, June 12, 1906, B. H. Walden; *Melanotus* sp., Poquonock, May 28, Windsor, May 29, 1921, E. H. Jenkins.

It is quite probable that the wireworms descended into the ground on account of the extreme heat during the first week in June, but that they were able to feed upon the roots of the large plants later in the season, and possibly upon the old sprouting stumps after the tobacco crop had been harvested. Dr. Anderson observed some wireworms near the bottom of the furrows where one of the fields was being plowed late in the fall. Very little is known exactly about the life history of *Limonius agonus,* but some species require two years and others six years for the complete

life cycle. Probably the period required for the complete development of the eastern field wireworm falls somewhere between these limits. All wireworms are the larvae of click beetles of the family Elateridae, of which nearly 100 species occur in Connecticut.

On June 2, some tests were made with carbon disulphide emulsion applied with the tobacco setter when plants were being reset. Two different proportions were used: (1) one part of carbon disulphide in 360 parts of water, and (2) one part of carbon disulphide in 720 parts of water. Three days later (June 5), when we visited the plantation, it was found that the first or stronger mixture had killed nearly all of the plants, and the second or weaker had not killed the wireworms.

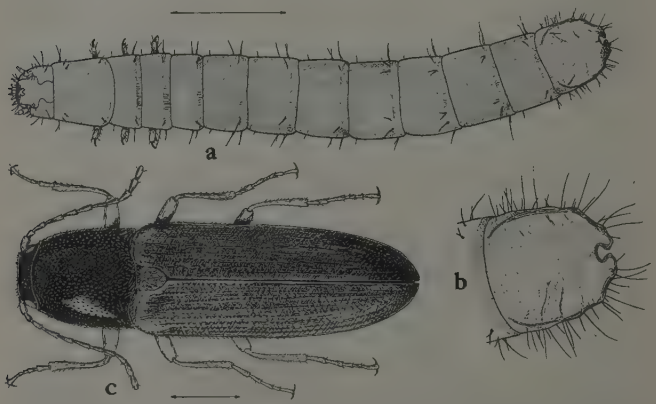


FIG. 48.—The Eastern Field Wireworm, *Limonius agonus*, a. larva; b. posterior segment of larva; c. adult beetle. All enlarged. Natural length of larva and adult indicated by the lines.

Tests were also made with calcium cyanide, which seemed to be effective in killing the wireworms, but also injured the plants. In California the bean crop is often severely injured by wireworms, and the growers now forestall injury by planting every fourth or fifth row with split seed which will germinate but not make strong plants. The wireworms are attracted to these weak plants and then calcium cyanide is drilled in along each row and kills both wireworms and plants. After waiting a few days, the crop can be planted without further injury.

Plans have been made for conducting further experiments next season, and it is hoped that we may be able to obtain some definite data regarding wireworm control.

MOSQUITO CONTROL WORK IN CONNECTICUT

Season of 1925

R. C. Botsford

There are about 40 different species of mosquitoes in Connecticut, but for convenience in practical control work, the most important of these are included in four general groups, as follows: salt marsh, fresh water swamp, malaria, and rain barrel.

Mosquito control work in Connecticut as carried on by the Connecticut Agricultural Experiment Station is confined largely to the eradication of mosquito breeding places on the salt marshes. The salt marsh mosquitoes are considered the greatest nuisance. They breed periodically from April to October in certain depressions in the salt marshes. Their breeding areas occur near large centers of population and almost surround the cottages and summer homes which line our shores, and in addition they are known to fly five or 10 miles and infest areas where no breeding occurs.

Every intelligent person knows that mosquitoes can breed, or develop, through the egg, larval and pupal stages, only in still or stagnant water. This means that if there were no stagnant water, there would be no mosquitoes. Standing water on a salt marsh which tends to breed mosquitoes is removed through a simple system of ditches. These ditches are usually 24 inches deep, about 150 feet apart, and as wide as necessary to carry off the volume of water deposited on the salt marsh at high tide or by heavy rains. Fresh water swamps may be drained by a similar system of ditches, or if an outlet is impracticable, the surface water may be made to accumulate in a deep artificial pool stocked with larva-eating minnows. Receptacles holding water should be emptied once each week or, if in use, should be screened to prevent the adult mosquito from depositing its eggs upon the surface of the water.

Oiling or treating the water chemically are but temporary measures and are recommended only where drainage or fish control are impossible.

Unditched salt marshes which in some cases averaged as high as 80 per cent mosquito-breeding surface are now, since being ditched, practically free from breeding places and will remain so as long as the ditches function properly. It is just as important that the ditches be inspected regularly and kept open as to have the original ditching done; because clogged ditches will hold water and may breed mosquitoes in addition to all other depressions nearby, and the marsh would soon revert to its original condition and become a serious breeding place. Ditches should be inspected about once each month and stoppages removed. (See Plate XIV.)

There are over 5,000 acres of ditched salt marshes in Connecticut patrolled regularly throughout the mosquito breeding season under the supervision of the Connecticut Agricultural Experiment Station. Not only are ditches cleared and recondi-

tioned, but tide-gates, dikes, culverts, etc., are kept in repair as far as funds will permit.

STATUS OF CONNECTICUT SALT MARSH AREAS, 1925.

Town	Salt Marsh Acres	Salt Marsh Ditched	Maintained by State	Total Cost of Ditching	Labor, Cost of Maintenance 1925	Labor, Cost to Complete
Greenwich			None			
Stamford	300	300	200	$2,800.00	$177.20	
Darien	300	300	None	3,800.00		
Norwalk	600	600	None	7,500.00		
Westport	350	50	50	Ditched with Fairfield		$5,500.00
Fairfield	1,200	1,200	1,200	8,400.00	971.50	
Bridgeport	173					3,000.00
Stratford	1,315					20,000.00
Milford	630					9,500.00
West Haven	463	222	222	Ditched with New Haven	52.00	3,500.00
New Haven	750	750	750	12,000.00	528.00	
Hamden, No. Haven	2,042					30,000.00
East Haven	482	150	50	Ditched with New Haven	44.00	6,500.00
Branford	895	578	578		832.50	4,800.00
Guilford	1,085	1,085	1,085	20,000.00	1,140.68	
Madison	1,005	1,005	1,005		986.17	
Clinton	766					12,000.00
Westbrook	500	170	None	2,746.07	4.00	4,754.00
Old Saybrook	1,373	60	None			20,000.00
Lyme	493					7,500.00
Old Lyme	1,393					21,000.00
East Lyme	424					6,500.00
Waterford	204					3,500.00
New London	34					500.00
Groton	304	50	50	1,000.00	8.00	4,000.00
Stonington	555					8,500.00
	17,636	6,520	5,190	$58,246.07	$4,744.05	$171,054.00

According to old Government figures, there are about 22,000 acres of salt marsh in Connecticut. This figure, we believe, includes the grassy areas completely covered by normal high tides, which cannot breed mosquitoes. The mosquito-breeding areas are further reduced by fills, especially near large cities. For practical purposes we presume there are 18,000 acres of ditched and unditched salt marshes in Connecticut. In some instances mosquitoes migrate from unditched areas and infest communities where local control may be perfect. The remaining 13,000 acres of salt marsh should be ditched to make control work most effective. The cost of ditching has increased about 100 per cent. since 1916. The cost of maintenance, when extensive repairs are not included, averages about one dollar per acre.

Although salt marsh work claims most of our attention, we have some requests to investigate communities where fresh water species are troublesome. The fresh water species have a much shorter flight range from their breeding place than the salt water mosquitoes, and where they are troublesome, they are generally found breeding on the infested premises or within a few hundred yards.

The officers of the Boy Scouts of Meriden made arrangements with the local health officer to carry on some anti-mosquito work this summer in the City of Meriden. A careful survey of the possible breeding places was made, and maps prepared by the Scouts. It was rather late in the season (June 10) to expect great relief, but in sections where the swamps and pools were systematically oiled, a reduction in the number of mosquitoes was reported.

The town of Clinton voted $10,000 to ditch the salt marshes of the town for mosquito elimination.

Mosquito control is a vital factor in the progress and development of this State, and more State funds should be provided in order that the work may be completed and past expenditures made more effective.

The table on page 316 shows approximately the present condition of the salt marsh areas in Connecticut.

THE WORK BY TOWNS

New Haven

In spite of the wet season, there was less mosquito *breeding* in the New Haven salt marshes this year than the two previous years. This was due to the progress made in recutting and grading damaged ditches.

However, New Haven was badly infested with salt marsh mosquitoes this summer, especially in the Prospect Hill section. The salt marsh nearest this part of the city is the great Quinnipiac River marsh of over 2,000 acres. The greater area of this marsh lies above the New Haven line and is unditched and contains breeding places. Prolific breeding has also occurred this summer in certain salt marshes of East Haven and West Haven.

The large marsh area near Morris Cove was ditched in 1912 for mosquito elimination. This area was never accepted by the State for maintenance, and now only traces of ditches remain. It is doubtful, however, if this is a breeding place of the salt marsh or migrating mosquito such as infests the city each summer, because an excellent tide-gate on Morris Creek seals this area against entry of ocean water. It is probable that all native species of fresh water mosquitoes, including the malaria mosquito, breed in this swampy area and torment local residents. Mosquito breeding in this section would be much lessened if Morris Creek were

dredged to the East Haven line at Dodge Avenue. Present insanitary conditions would be removed and property values tend to increase.

New Haven will have salt marsh mosquitoes so long as its neighboring towns remain unditched.

West Haven

Due to lack of State funds necessary to improve the outlet of Old Field Creek at Beach Street, immense broods of mosquitoes emerged from the Old Field Creek marsh this summer.

On June 6, 1925, Dr. Charles D. Phelps was appointed local Deputy in Charge of mosquito elimination. Through his efforts, enough local funds were made available to keep the outlet of Old Field Creek open the latter part of the season.

The key to the principal mosquito control problem in West Haven is the outlet of Old Field Creek at Beach Street. Our recommendations made in 1923 and 1924 offer a practical solution and are quoted: (1923) "The outlet from the gate to the harbor should be deepened about two feet and a sluiceway (pipe) installed to extend beyond the sand bar. A new tide-gate is required (on pipe) and the creek should be dredged from Beach Street to Peck Avenue," and (1924) "A sluiceway (pipe) with tide-gate should be installed in the outlet of the Old Field Creek, extending from Beach Street about 300 feet into the bay, and the creek dredged from Beach Street to Peck Avenue." After this is done it will be possible to clean out the ditches and keep them in good condition.

East Haven

The small salt marsh areas at Morris Creek and Caroline Creek under State care were practically free from mosquito breeding places the entire season. The other salt marsh areas in this town need more ditches in order to remove stagnant water from the marsh surface.

Mosquitoes of the fresh water species were very abundant and troublesome this year. The margins of Tuttle's Brook and the large swamps near the railroad track furnish typical breeding places. The presence of rain barrel mosquitoes indicated back-yard breeding places, such as barrels, tubs, pails, tin cans or other articles which may hold water.

Branford

The salt marsh of Stony Creek is in bad condition due to a leak under the foundation of the dike. Some temporary repairs were made, but it is planned to make permanent repairs on this dike this winter. The other salt marshes which were ditched for mosquito

elimination were patrolled throughout the season and the ditches kept open.

Mosquitoes were reported as being troublesome in certain localities and an investigation of the unditched salt marshes west of the Branford River revealed many breeding pools capable of supplying the town with mosquitoes.

Local interest in Pine Orchard and Indian Neck kept those communities free from fresh water species in spite of the frequent showers, which tend to keep fresh water swamps and hidden receptacles supplied with water.

The tide-gates on the Branford River were kept in fair service by constant patching. It is doubtful if these gates can be made to go through next season. A bid has been received for the complete reconstruction of these gates, but no money is available to carry on the work.

Conditions around Waverly Grove may be improved by a tile outlet near Lounsbury's Store.

Guilford

Extensive repairs were begun in September, recutting and grading ditches in the salt marshes of this town. It is planned to have all ditches open before next season.

Storm damage to the dike at Great Harbor is being repaired by the property owners.

Madison

The Town of Madison voted $200.00 for mosquito control work. This will be added to the regular State allotment for the town and will allow some much needed work to be done.

Iron culverts installed in the beaches functioned perfectly throughout the season. This resulted in much improved drainage which facilitated repair work on the ditches.

The State Park and Forest Commission has made available a limited amount of funds for anti-mosquito work in Hammonassett Park.

Westbrook

Another $1,000.00 was appropriated by the town to carry on their anti-mosquito program, and the work of ditching continued as usual.

Salt marshes near the center of the town and eastward to the Saybrook line have been ditched and are practically mosquito proof. Mosquitoes which were reported troublesome did not come from the ditched marshes. Breeding was heavy in the unditched marshes bordering the Patchog and Menunketesuck Rivers. Ditching of these marshes began this fall. (Plates XV and XVI.)

Groton

Ditches in this area were cleaned, recut and graded as required.

Fairfield

In the Town of Fairfield, $2,899.52 was expended for the maintenance and extension of fresh water drainage work. The bulk of this sum was furnished by popular town vote, the Fairfield Improvement Association and the Health Department each adding a good share. This sum does not include what the State regularly supplies.

The inspection work through the season was much handicapped by the continued ill health of Nicholas Matiuck. All infestations reported were investigated and breeding places destroyed. Most of the breeding places found were the result of recent construction work.

Stamford

The City of Stamford added $300.00 to the State funds for inspection and maintenance work. The work was carried on by experienced labor from Fairfield.

Following is a copy of an order and notice such as may be mailed to the land owners prior to ditching or otherwise treating such land for mosquito elimination:

Order and Notice Concerning Elimination of Mosquito Breeding Places in the Town of ————.

Whereas, by the provisions of Chapter 68 of the Public Acts of 1923, the Director of the Connecticut Agricultural Experiment Station may make rules and orders concerning the elimination of mosquitoes and mosquito breeding places, and he or his agent may enter upon any swamp, marsh or land to ascertain if mosquitoes breed thereon or to survey, drain, fill or otherwise treat, or make any excavation or structure necessary to eliminate mosquito breeding on, such land or cause same to be done, and

Whereas, sufficient funds have been raised to so eliminate mosquito breeding places within the areas hereinafter mentioned and described,

Now Therefore, I, William L. Slate, Jr., Director of the Connecticut Agricultural Experiment Station, by authority of said Chapter 68 of the Public Acts of 1923, hereby order that all mosquito breeding places be eliminated in the following areas in the Town of ..... in the County of ....., State of Connecticut, to wit: (Here follows a description of the areas and method to be used.)

Map showing these areas is on file in the office of the Town Clerk of the Town of .....

Said elimination shall be by the ditching of all marsh areas within the above mentioned territory where either storm water or tide water does or may stand for several days. Ditches to be near enough together and deep enough to drain all such areas effectively, and main ditches, and natural waterways made as required to carry the drainage. Tide gates, dikes and other structures shall be made, if necessary, and artificial outlets constructed where natural outlets may not be made effective.

All said work shall be under the supervision of and subject to the approval of the Director of the Connecticut Agricultural Experiment Station.

Dated at New Haven, Connecticut, ...

WILLIAM L. SLATE, JR., *Director.*
Connecticut Agricultural Experiment Station.

MISCELLANEOUS INSECT NOTES

A Scale Insect New to Connecticut: During the summer of 1925, the writer discovered a white scale of the genus *Eriococcus* on some shrubs of *Spiraea salicifolia* growing on his home grounds. Specimens were identified by Mr. Harold Morrison of the Bureau of Entomology as *Eriococcus borealis* Cockerell (shown on Plate XVII, b.), a species not before recognized as occurring in Connecticut.

Birch Twig Gall: On July 18, 1924, the writer observed a peculiar swelling at the base of a twig on paper or canoe birch, that resembled the swellings or galls caused by certain species of *Agrilus*. The twig was removed from the tree and placed in a cage in the insectary. On April 24, 1925, an adult beetle of *Neoclytus acuminatus* Fabr., emerged.

Lace-Bugs Injuring Elm Foliage: On August 27, Mr. W. O. Filley brought to the office some elm leaves from Canaan, which had the under sides covered with excrement and cast skins. On September 4, Mr. Filley brought similar material from West Cornwall. Both lots of leaves had been attacked by the elm lace-bug, *Corythucha ulmi* Osborn and Drake, and some adults were present. This species, first described from Ohio in 1916, was received on elm from Litchfield in 1922.

Conservatory or Asiatic Camel Cricket in Connecticut: On December 17, a specimen from a greenhouse in Southport was handed me for identification. Mr. Walden found it to be the conservatory or Asiatic camel cricket, *Diestrammena japonica* Blatchley (*marmorata* DeHaan), an Oriental species which has been reported from Minnesota, Wisconsin, Kansas, Illinois, Ohio, Canada, Maine, Massachusetts and Rhode Island, usually occurring in cellars or greenhouses. This is the first record for Connecticut and it is not known whether this cricket injured the plants. If so, some means of control must be devised.

Borer in Willow Twigs: On August 20, while inspecting nurseries in Durham, Mr. Zappe found some yellow bark willows

with borers at work in the shoots some distance back from the tips, and where the shoots were about the size of one's finger. He gathered material and brought to the insectary, and on August 26 two adults emerged and on August 30 another adult appeared in the cage. These specimens seem to be identical with those of *Janus abbreviatus* Say, in the Station collection, and also run to it in the key to the species of *Janus* in the Hymenoptera of Connecticut.

Abundance of Cherry and Pear Slug: The cherry and pear slug, *Caliroa cerasi* Linn., has often been noticed feeding upon the leaves of small pear and cherry trees in nurseries or young orchards, but seldom does it attack and injure large trees. When inspecting nurseries, Mr. Zappe observed an old and large sweet cherry tree in Cromwell which was perhaps 35 feet tall and the foliage had been skeletonized and was brown from the feeding of the larvae. Particularly the top and the south side of the tree showed this condition. On the north side, the lower branches were somewhat greener. Mr. F. A. Bartlett reported to the writer that late in the season he had also seen large trees in Fairfield County with foliage brown from the attacks of this insect.

Abundance of Grasshoppers: Grasshoppers were very abundant in certain localities. Reports were received from Woodbridge and Guilford, and a visit was made to Guilford, August 15, where the second crop of grass had been cut. Grasshoppers were plentiful and rose in swarms from the grass, when the mowing machine passed through the field. Nearly all stages were present. A few mature specimens were collected and Mr. Walden identified them as the red legged grasshopper, *Melanoplus femur-rubrum* DeGeer. Another nearby farm had a 10-acre field of alfalfa which, according to report, had been nearly ruined by grasshoppers. Poisoned bait of bran mash scattered about the field is perhaps the best remedy and is used very extensively in some of the western states.

European Pine Mite in Connecticut: On November 12, 1924, in compliance with a request, the writer examined some conifers growing close to the front porch of the residence of Mr. Clarence L. Beardsley, 244 McKinley Avenue, New Haven. Some of these conifers had been attacked by mites and the leaves were light colored. Two Scotch pines had peculiar bunchy or "witches broom" growths at the upper terminals as shown on Plate XVII, a. Some of these growths were removed and taken to the laboratory, where they were examined by Dr. Garman. He found mites in them which he identified as the European pine mite, *Eriophyes pini* Nal., a species which at that time had not been reported as occurring in the United States. The record was overlooked and

therefore was not published. Recently this mite has been reported by Walther* as injuring pine trees on the Pacific Coast. Spraying with a miscible oil, one part in ten parts of water, has given promising results in California, but further investigations are needed before we can recommend any treatment for Connecticut.

Sawfly Larvae Feeding upon Rudbeckia "Golden Glow": In the Report of this Station for 1924, page 342, was published a note regarding sawfly larvae found feeding upon "golden glow" in Westport, and illustrations were shown on Plate XXXVI.

FIG. 49.—Adult Sawfly, *Macrophya simillima*. Enlarged about six times.

Mention was made of an adult sawfly of the species *Tomostethus inhabilis* Norton, which had been reared from the material, though probably occurring there accidentally. On May 26 and June 7, 1925, some much larger sawflies emerged from the soil in the same cage, and were identified by Mr. S. A. Rohwer of the U. S. National Museum as *Macrophya simillima* Rohwer. On May 25, Mr. Friend collected several specimens of the same species on the bed of "golden glow" at Westport, and on June 20, Mr. Friend and the writer collected many larvae there, and brought back plants upon which to feed them. Heretofore the food plant and

* Journal of Economic Entomology, Vol. 18, page 830, December, 1925.

habits of the species were unknown. It is also a species not before recorded as occurring in Connecticut. The original description was published in Entomological News, Vol. 28, page 265, 1917, and was drawn from material collected in St. Louis, Mo., and Lincoln, Nebraska. There is no doubt about this species being responsible for stripping the plants of "golden glow." The adult sawfly is shown in Figure 49, and the egg-blister on Plate XIX, b.

Noctuid Larvae Injuring Young Apple Trees: On May 6, Mr. Zappe brought to the insectary some Noctuid larvae found in a nursery in Durham, which has caused much injury to young apple trees by eating off the buds which had been set in the stocks the preceding summer, as shown on Plate XVIII, b. The larvae were plentiful on the ground. On May 12, larvae were scarce, but much injury was evident. Not only had the buds been eaten, but the bark had also been entirely eaten from some of the stocks. The lower leaves of nearby raspberry plants had also been eaten, leaving only the mid-ribs, as shown on Plate XVIII, a. Leaves 12 inches or more above the ground were uninjured. Only nine larvae could be found on May 12, and these were beneath the surface of the soil under newly-injured plants. As there seemed to be two different species of larvae, they were placed in separate rearing cages, and on June 15 adult moths of both species emerged. They proved to be *Agrotis unicolor* Walker (formerly known as *Noctua clandestina* Harris) and *Noctua fennica* Tausch., both species being shown on Plate XVIII, c, and d. One Tachinid parasite emerged from the latter June 7, and has been identified as *Phorocera claripennis* Macq., by Dr. J. M. Aldrich of the U. S. National Museum.

Pears Injured by Quince Curculio: During late August and September, Seckel pears in the writer's home garden dropped heavily before ripening, and usually on one side of each fruit there was a hard flattened area with indication of insect punctures. On cutting open the fruit, small legless grubs were found in cavities between the skin and the core. An examination of these grubs showed them to be curculio larvae. Messrs. Zappe and Stoddard made a trip into eastern New York State during June, and after their return reported much damage to pears during the preceding year from the attacks of the quince curculio, *Conotrachelus crataegi* Walsh. On December 17, 1925, Professor P. J. Parrott, Entomologist of the New York Experiment Station at Geneva, N. Y., gave an address before the Connecticut Pomological Society at Hartford, and from photographs of the injury, he identified it as the work of the quince curculio. Material was gathered and placed in cages in the insectary, but the adults have not yet been reared; they are not expected to emerge until May or June. There is

one generation each season and the grub on leaving the fruit goes into the soil and remains there through the winter. The grub and the appearance of injured fruit is shown on Plate XX, b, and c, of this Report.

The Rose Stem Girdler in Connecticut: On September 8, stems of *Rosa rugosa* were received from Darien, having the peculiar characteristic swellings or galls caused by the rose girdler, *Agrilus viridus,* var. *fagi* Ratz. These stems are shown on Plate XIX, a. On October 14, stems of *Rose hugonis* with similar swellings or galls were received from Norwalk, adjoining Darien. Though no adults have been reared from these stems, the injury so closely resembles that described and figured by Weiss* as occurring in New Jersey, that we have no hesitancy in ascribing it, at least tentatively, to that species. which occurs in Europe and has been recently recorded from New Jersey. The swelling is elongate, and the stem diameter increased sometimes only slightly and in other cases nearly doubled. Sometimes the stem is swollen and enlarged at several places. The adult is said to be a small metallic coppery beetle, about one-third of an inch long, which lays eggs singly on the bark in June and July. The young larva enters the sapwood and makes a series of spiral tunnels close together around the stem for a distance from one to two and one-half inches. The larval period is said to extend over a period of two years and pupation takes place in a cell in the stem from three to six inches above the swelling. Not only does this beetle injure rose, but it is known to attack birch, beech, alder, oak and poplar. The only known remedy is to cut and burn the infested stems in winter or spring before the beetles emerge.

Tobacco Injured by Tipulid Larvae: On June 5, the writer visited a large tent tobacco plantation in Windsor, where some maggot injury (probably seed-corn maggot, *Hylemyia cilicrura* Rond.) had been reported. Many injured plants were found, but no white maggots, though the foreman said that he had found some of them this season. Many of the plants had been injured near the surface of the ground, and the injury was somewhat larger than is usually caused by the seed-corn maggot, as well as being higher up on the side of the stem. There were many "leather jackets" or cranefly (Tipulid) larvae in the surface layer of the soil and we wondered whether or not they were responsible for the injury. A number of empty pupa cases were found protruding from the surface of the ground. Many larvae were collected and brought to the laboratory, and larvae and injured plants

* New Jersey State Department of Agriculture, Bureau of Statistics and Inspection, Circular No. 36, page 9, 1921; Circular No. 48, page 13, 1922.

were photographed. These larvae were placed in a cage outside the insectary and some uninjured plants set in the cage with the larvae, the surface of the soil being kept at the ground level. On June 8, two plants in the cage showed the same form of injury as those collected in the field. On September 9, one adult fly emerged. Adult, larva and injured plant are shown on Plate XIII. This was identified as *Nephrotoma ferruginea* Fabr., by Professor C. P. Alexander of Amherst, Mass. Two or three adults found resting on the tent June 5 proved to be the same species. Apparently this is one of the first records, if not the first, of Tipulid injury to young tobacco plants. According to the Insect Pest Survey Bulletin, Dr. H. T. Fernald observed similar injury to tobacco plants in Hadley, Mass., in June 1925, which he attributed to cranefly larvae.

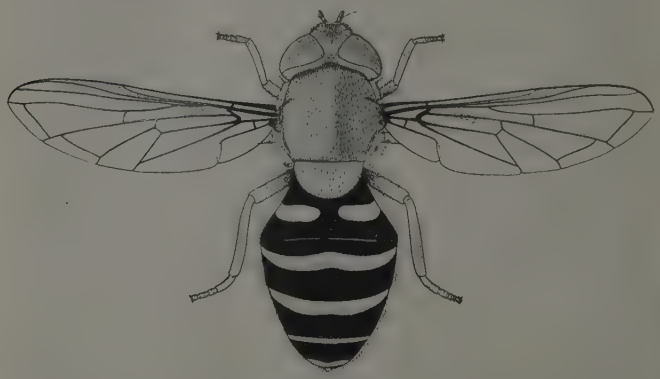


FIG. 50.—Adult Syrphid Fly, *Syrphus torvus*. Enlarged about five times.

Syrphid Eggs and Larvae on Apple: While engaged upon some fruit survey work in the spring of 1925, Mr. E. M. Stoddard and the writer found the eggs of Syrphid flies quite common on the young unfolding apple leaves. (See Plate XIX, c.) They were particularly abundant near colonies of aphids. The eggs are laid singly but frequently two or three could be found on a single leaf. The larvae of these Syrphid flies feed upon aphids. They have often been seen before, but for several years the eggs have not been as abundant as in the spring of 1925. The eggs of this insect were found in the following towns: Wallingford, Wilton, Middlefield, Middletown, Litchfield, Newington, Cheshire, Southington, Washington, Milford, Vernon, Durham and Groton.

Many of the orchards where Syrphid eggs were found were visited again later in the season and aphids had apparently been held in check by this insect; in some cases there were hardly enough aphids to satisfy the appetites of the Syrphid larvae. It was not uncommon to find a twig which bore evidence that many aphids had been present, but had all disappeared, having been eaten by Syrphid larvae, which could be found on the nearby leaves. Frequently a larva could be found in a leaf which had been rolled by a colony of aphids, but the aphids had been nearly all eaten. On April 17, 1925, a number of Syrphid eggs were collected and placed in breeding cages with aphid infested twigs. The eggs hatched and all larvae were full grown by May 9, and began to pupate. Adults began to emerge from the pupae on May 22, and the last one emerged May 27. An examination of the adults proved them to be *Syrphus torvus* O. S., a species which in the larval or worm stage commonly feeds on aphids. The flies themselves do not feed on aphids, but are said to feed on the nectar of flowers. The adult flies look very much like small bees, and are often mistaken for them. This insect was also reared from larvae collected on peach leaves where they were found feeding on aphids. At Cheshire, Hamden and Southington, these larvae were reported to be doing splendid work in checking an outbreak of peach aphids, probably *Myzus persicae* Sulzer. The adult fly is shown in Figure 50.

M. P. Zappe.

INDEX

Acronycta rumicis, 246
Agrilus viridus var. *fagi*, 325
Agrotis unicolor, 324
Alsophila pometaria, 221
Altica chalybea, 221
American foul brood control, 248, 291
Anasa tristis, 226
Anastatus bifasciatus, 270, 271
Anomala orientalis, 218, 227, 309
Anthrenus scrophulariae, 230
Anuraphis roseus, 222, 278
Aphids, cabbage, 226
  cherry, 237
  green apple, 222, 237, 278
    delayed dormant sprays for, 278
  green peach, 222, 327
  hickory leaf stem gall, 228
  larch leaf, 237
  pea, 226, 227, 295
  potato, 226
  rosy apple, 222, 278
  spring grain, 278
  spruce gall, 228, 237, 238
  willow, 237
  woolly apple, 228, 237
Aphidius rosae, 298
Aphis pomi, 222, 278
  pseudobrassicae, 226
Aporia crataegi, 246
Apple and thorn skeletonizer, 220, 237, 238
Apple scab, 237
Apple maggot, 222
Army worm, 227
Asaphes sp., 313
Asiatic camel cricket, 321
Aspidiotus perniciosus, 223
Asterolecanium variolosum, 228
Attagenus piceus, 230
Bacillus larvae, 248
  pluton, 247
Beetle, Asiatic, 218, 227, 309
  asparagus, 224
  black carpet, 230
  bumble flower, 221
  carpet, 230
  Colorado potato, 224
  cucumber flea, 224
  drugstore, 230
  elm leaf, 229, 237
  Japanese, 311
  May or June 227
  potato flea, 224
  raspberry, 222
  striped cucumber, 225
  12-spotted asparagus, 224
  willow leaf, 229, 237
Birch bucculatrix, 237
  leaf skeletonizer, 229
  twig gall, 321
Black knot, 237
Blatella germanica, 229
Blatta orientalis, 229
Borer, bronze birch, 237
  European corn, 224, 303
  lilac, 237
  poplar, 237
  squash, 224
  stalk, 224
  willow, 237, 321
Brevicoryne brassicae, 226
Brown rot, 237
Bryobia pretiosa, 230
Bucculatrix canadensisella, 229
Bud moth, 220
Buffalo bug, 230
Byturus unicolor, 222, 302
Cabbage maggot, 225
Calendra granaria, 230
Caliroa cerasi, 322
Calophasia lunula, 246
Canker on poplar, 237, 238
Carpocapsa pomonella, 221
Chermes abietis, 228, 237
  cooleyi, 228, 237
Cherry and pear slug, 237, 322
Chionaspis furfura, 223
  pinifoliae, 228
Chloridea obsoleta, 224
Cirphis unipuncta, 227
Clothes moth, 230
Codling moth, 221
Coleophora laricella, 227
Conotrachelus crataegi, 221, 234
  nenuphar, 221
Conservatory cricket, 321
Corn ear worm, 224
Corythucha ulmi, 321
Cranefly larvae, 325
Crepidodera rufipes, 221
Crioceris asparagi, 224
  duodecimpunctata, 224
Crown gall, 237, 246
Cryptorhynchus lapathi, 229

Curculio, plum, 221, 286
quince, 221, 324
Cutworms, 222, 223
Diabrotica vittata, 225
Dichomeris marginellus, 230
Diestrammena japonica, 321
marmorata, 321
Diprion simile, 237
Dusting and spraying experiments, 272
Emphytus cinctus, 246
Empusa aphidis, 296
Ephestia kuehniella, 230
Epitrix cucumeris, 224
Eriococcus borealis, 321
Eriophyes pini, 322
pyri, 220
quadripes, 229
Eubadizon sp., 281
Eulia velutinana, 220, 298
Euphoria inda, 221
European pine shoot moth, 237
foul brood, 247
Fall cankerworms, 221
Fall web-worm, 228, 237
Fenusa pumila, 218, 229
Fire blight, 237
Galerucella xanthomelaena, 229
Gelechiidae sp., 246
German cockroach, 229
Gipsy moth, 253
parasites, 270
statistics of infestations, 267
Glypta rufiscutellaris, 281
Granary weevil, 230
Grapevine flea-beetle, 221
Green cabbage worm, 224
Hemerophila pariana, 220
Hylemyia brassicae, 225
cilicrura, 325
Hyphantria cunea, 228
Illinoia pisi, 226, 227, 297
Imported currant worm, 218
Inspection, Apiary, 246
Imported stock, 244
Nursery, 232
Ips pini, 229
Janus abbreviatus, 322
Juniper web-worm, 230
Lace bugs on Crataegus, 237
elm, 329
rhododendron, 237
Larch case bearer, 227
Laspeyresia molesta, 219, 237
Leafhoppers on apple, 237
lilac, 237
Leaf-miner, birch, 218, 229
box, 230
larch, 227
spinach, 226
Leaf spot on catalpa, 237
pear, 237
quince, 237
rose, 237
Leather jackets, 325
Lepidosaphes ulmi, 223
Leptinotarsa decemlineata, 224
Leptocryptus lacustris, 246
Limonius agonus, 313
Lina scripta, 237
Lygocerus niger, 298
Lygus pratensis, 226
Macrocentrus ancylivora, 281
Macrophya simillima, 323
Macrosiphum solanifolii, 226
Malacosoma americana, 220
Maple bladder gall, 229
Mediterranean flour moth, 230
Megorismus fletcheri, 298
Melanoplus femur-rubrum, 322
Melanotus sp., 313
Melittia satyriniformis, 224
Mildew on apple, 237
catalpa, 237
cherry, 237
grapes, 237
horsechestnut, 237
lilac, 237
rose, 237
spiraea, 237
Mite, box, 237
clover, 230
European pine, 322
red, 218, 220, 237
on silver maple, 237
pear leaf blister, 220, 237
spruce, 229, 237
Monarthropalpus buxi, 230
Mosquitoes, control work, 315
Fresh water swamp, 315
Malaria, 315
Rain barrel, 315
Salt marsh, 315
Myzus persicae, 222, 327
Neoclytus acuminatus, 321
Neodiprion pinetum, 229
simile, 229
Neoprociphilus aceris, 228
Nephrotoma ferruginea, 326
Noctua clandestina, 324
fennica, 324
Noctuid larvae on apple, 324
Notolophus antiqua, 246
Onion thrips, 226
Oriental cockroach, 229
peach moth, 218, 219, 280
Papaipema nitela, 224
Paratetranychus pilosus, 220
ununguis, 229

Peach yellows, 237
Pear psylla, 221, 292
Pegomyia hyoscyami, 226
Phenacoccus acericola, 228
Phorocera claripennis, 324
Phyllophaga sp., 227
Phylloxera caryaecaulis, 228
Pine sawfly, 237
Plagiodera versicolora, 229, 237
Pontia rapae, 224
Popillia japonica, 311
Poplar and willow curculio, 229, 237
Psylla pyricola, 221, 292
Peteronidea ribesi, 218
Pulvinaria vitis, 227
Pyrausta nubilalis, 224, 303.
Raspberry anthracnose, 237
  fruit worm, 222, 302
  mosaic, 237
Red-banded leaf-roller, 220, 298
Red-humped caterpillar, 220, 237
Red legged grasshopper, 322
Reticulitermes flavipes, 230
Rhagoletis pomonella, 222
Rose stem girdler, 325
Rust on hawthorn, 237
  cedar (on apple), 237
    (on cedar), 237
  sweet fern (on pine), 237
  on willows, 237
  white pine blister (on Ribes), 237, 238
Sacbrood, 249
Sawfly, pine, 229
  Rudbeckia, 323
Scale, cottony maple, 227
  elm, 237
  oak gall scale, 237
  oyster-shell, 222, 237, 238
  pine leaf, 228, 237
  pit making oak, 228, 237
  rose, 237
  San José, 223, 237, 238
  scurfy, 223, 237
  tulip tree, 227, 237
  white elm, 237
  woolly maple leaf, 228
Schizura concinna, 220
Seed-corn maggot, 325
Sitodrepa panicea, 230
Spinach maggot, 226
Squash bug, 226
Syrphid flies, 326
Syrphus torvus, 326, 327
Tarnished plant bug, 226, 237
Tent-caterpillar, 220, 237
Thrips tabaci, 226
Tineola bisselliella, 230
Tmetocera ocellana, 220
Tomostethus inhabilis, 323
Toumeyella liriodendri, 227
Toxoptera graminum, 278
White ant, 230
White grubs, 227, 237
White pine weevil, 237, 238
Wireworms, eastern field, 227, 312

a. Infestation No. 5, Norfolk, 83 egg-clusters.

b. Infestation No. 3, Colebrook

GIPSY MOTH INFESTATIONS.

a. Infestation No. 1, East Granby, 8 egg-clusters on willows.

b. Infestation No. 2, North Canaan, 208 egg-clusters.

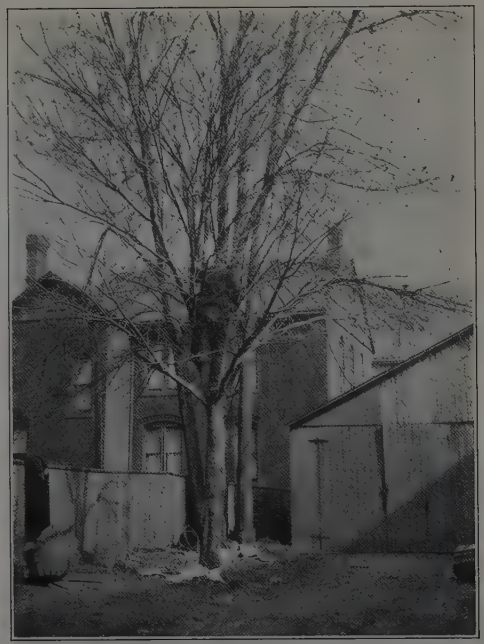
GIPSY MOTH INFESTATIONS.

a. Infestation in Meriden, 11 egg-clusters.

b. New Haven infestation, 120 egg-clusters.

GIPSY MOTH INFESTATIONS.

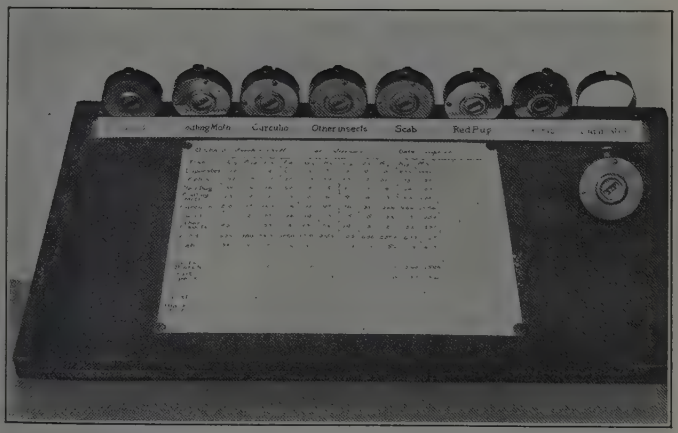
a. Spraying New Haven infestation.



b. Infestation No. 7, Hartford, 4 egg-clusters on maple and fence.

GIPSY MOTH WORK.

a. Gipsy moth parasite can containing *Anastatus bifasciatus.*



b. Battery of tally meters, with record sheet used in scoring fruit, much reduced.

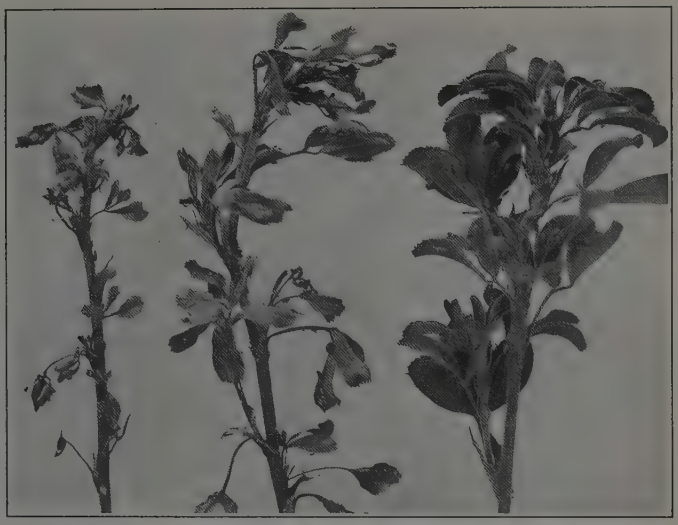
GIPSY MOTH WORK AND FRUIT SCORING APPARATUS.

PLATE VI.

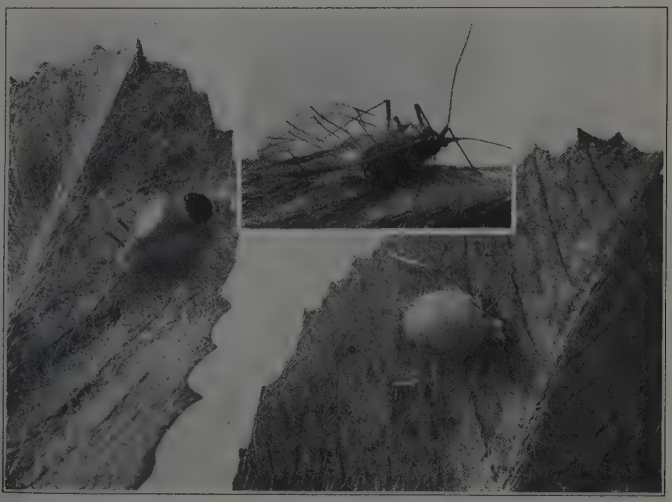
a. Outfit used in spraying peach trees, Conyer's farm, Greenwich.

b. Dusting outfit used at Conyer's farm, Greenwich.

ORIENTAL PEACH MOTH INVESTIGATIONS.



a. Alfalfa plants infested with aphids; two plants at left seriously injured. Somewhat reduced.



b. Wingless aphids killed by parasites, specimen at left showing exit hole of parasite; insert showing winged aphid killed by fungus. All enlarged six times.

PEA APHIDS ON ALFALFA.

a. Alfalfa shoot showing aphids killed by fungus. Somewhat reduced.

b. Alfalfa leaves showing aphids killed by fungus. Twice enlarged.

PEA APHIDS ON ALFALFA.

a. Strawberry blossoms, injured by adults of the raspberry fruit worm, natural size.

b. Grape vine buds injured by the grape vine flea beetle, *Altica chalybea,* twice enlarged.

WORK OF RASPBERRY FRUIT WORM AND GRAPE VINE FLEA BEETLE.

PLATE X.

a. Weed area to be burned near infestation, Noank.

b. Burning cornstalks at infestation in Stonington.

EUROPEAN CORN BORER WORK.

a. Adults showing variation from light brown to black, twice natural size.

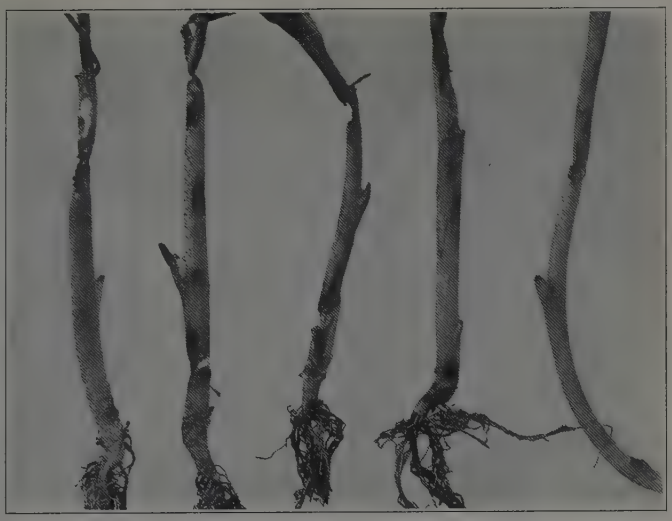
b. Lawn in Westville (New Haven); dark area shows grass killed by the grubs of the Asiatic Beetle.

ASIATIC BEETLE.

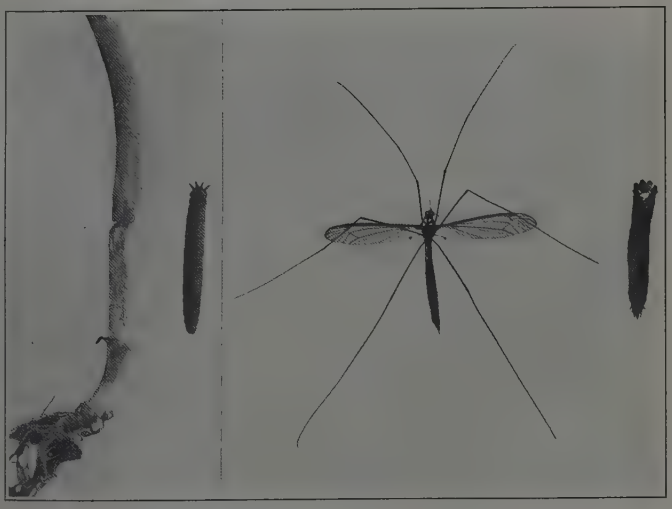
a. Injury to young plants, natural size.

b. View in tobacco tent where nearly all of the plants have been destroyed by wireworms.

WIREWORM INJURY TO TOBACCO.



a. Injury to plants. Natural size.



b. Adult, larva and pupa skin. Natural size.

CRANEFLY INJURY TO TOBACCO.

a. A large breeding area caused by the deliberate closing of one ditch.

b. Mosquito breeding pool caused by dumping rubbish in front of roadway culvert.

MOSQUITO CONTROL WORK.

a. Sods piled to prevent floating.

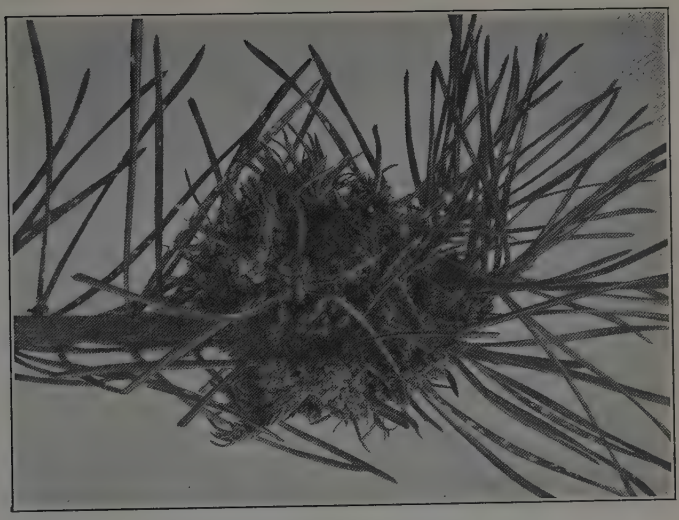
b. Hand cut ditch in salt marsh.

MOSQUITO WORK, WESTBROOK.

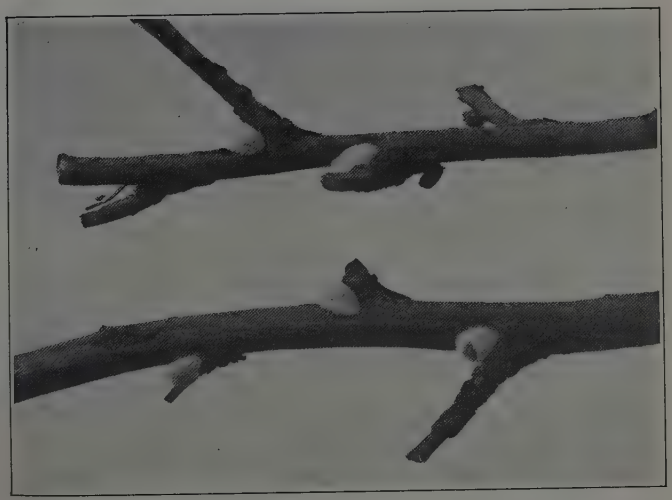
a. Draining salt marsh breeding pool.

b. Guide board being placed in position for cutting ditch with hay knives.

MOSQUITO WORK, WESTBROOK.

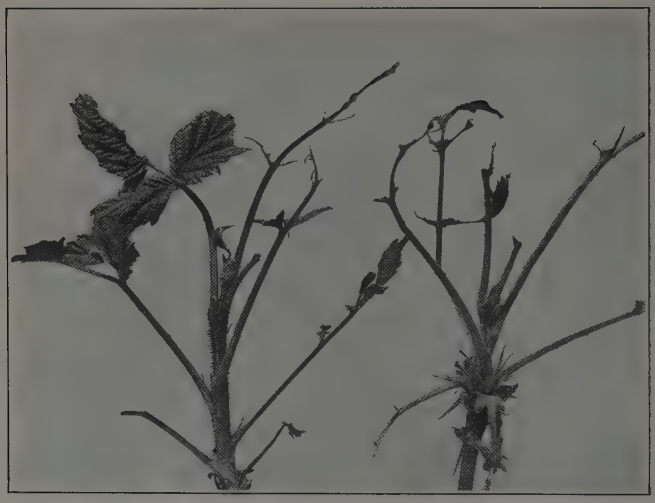


a. Gall of *Eriophyes pini* on Scotch pine, natural size.



b. *Eriococcus borealis* on *Spiraea salicifolia*, twice enlarged.

MITE AND SCALE INSECT NEW TO CONNECTICUT.



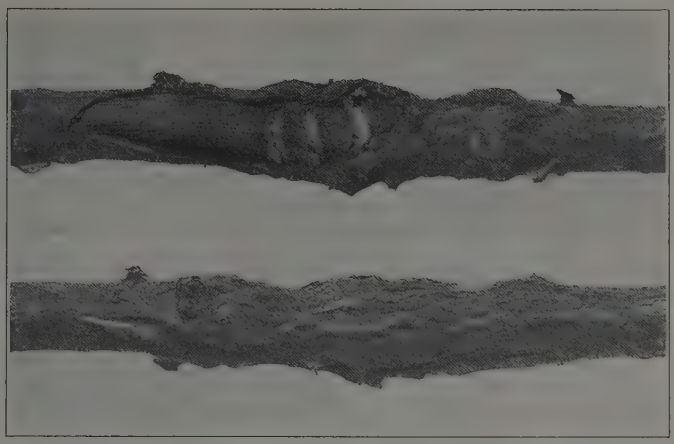
a. Raspberry plants stripped by Noctuid caterpillars.

b. Budded fruit trees, showing where buds were destroyed by Noctuid caterpillars, natural size.

c. *Noctua fennica,* natural size.

d. *Agrotis unicolor,* natural size.

INJURY CAUSED BY NOCTUID LARVAE.

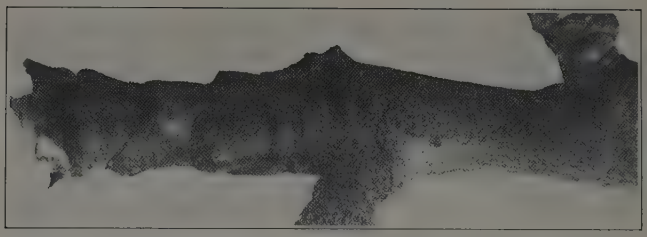


a. Galls of rose stem girdler, *Agrilus viridus* var. *fagi,* twice enlarged.

b. Leaf of "Golden Glow" showing on right an egg-blister of the sawfly, *Macrophya simillima,* twice enlarged.

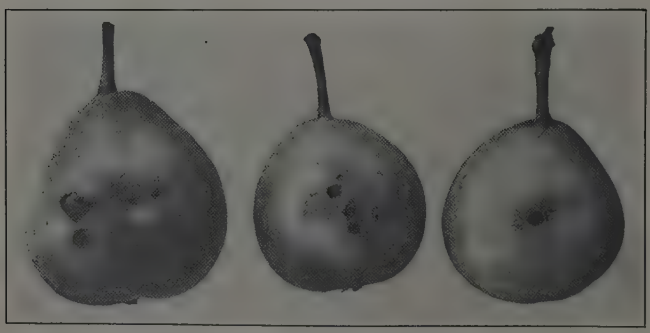
c. Eggs of *Syrphus torvus* on apple, enlarged ten times.

ROSE GALLS AND EGGS OF SAWFLY AND SYRPHID FLY.



a. Eggs of pear psylla on twig, about twice enlarged.

b. Section of Seckel pear infested with quince curculio, showing grubs, natural size.



c. External view of Seckel pears infested with quince curculio; somewhat reduced.

PEAR PSYLLA AND QUINCE CURCULIO.

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Connecticut Agricultural Experiment Station

New Haven, Connecticut

A Chemical Investigation of Some Standard Spray Mixtures

R. E. ANDREW AND PHILIP GARMAN

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THE TUTTLE, MOREHOUSE & TAYLOR COMPANY

A Chemical Investigation of Some Standard Spray Mixtures

R. E. Andrew* and Philip Garman

Modern spray practices have become complicated procedures. The necessity of attaining maximum efficiency with a minimum of labor has led in the case of fruit growing to the use of high powered outfits which apply spray mixtures at a rapid rate and to the combination of sprays in order to avoid separate applications. In the combination of sprays there has been much uncertainty of results and failure to explain certain phenomena which have not been well understood, at least from a chemical standpoint. For instance, we know that the ingredients of a certain spray formula mixed in a certain order give a definitely colored mixture, whereas an entirely different order of combination may give a different appearance. What goes on under these conditions as regards the ingredients themselves has only been conjectured by the entomologist, and it is in an attempt to throw some further light on what happens when various insecticides and fungicides are put together that the present work was undertaken.

Historical Summary

Probably the earliest studies of spray mixtures from a chemical standpoint were made by Bradley[2] and Bradley and Tartar[3], who found that there was a distinct chemical reaction between lime-sulphur and lead arsenate resulting in the formation of soluble arsenic. The latter undesirable condition was found to be greatly helped by the addition of lime to the mixture. Robinson[15], following this clue, described the beneficial action of lime upon the standard spray mixture and came to the conclusion that lime prevents the reaction between lime-sulphur and lead arsenate and does not lower the polysulphide sulphur in the lime-sulphur to a harmful extent. Ruth[17] made an extensive investigation of spray mixtures from a chemical standpoint, reaching the general conclusion that when these two components are mixed, a thioarsenate of some kind is formed which holds it insoluble in lime-sulphur solution, and that thiosulphates and sulphites are increased, possibly accounting for the improved fungicidal properties of the mixture. More recently Thatcher and Streeter[22] have investigated the addition of casein, gelatin,

* Until March, 1926, Assistant Chemist in the Analytical Laboratory.

nicotine and other preparations to the combined lead arsenate, lime-sulphur sprays, finding that casein-lime and nicotine exert a beneficial action upon the spray mixture. Still more recently, with the use of somewhat different methods, Goodwin and Martin[10] reached somewhat different conclusions, stating that casein and gelatin do not always protect lead arsenate from harmful reactions with lime-sulphur and in fact give an increased amount of soluble arsenic, contrary to the conclusions of Thatcher and Streeter. They found furthermore that lime decreased the amount of sulphur in solution in the spray mixture, thereby reducing its fungicidal value, but that lime, if carbonated, exerted little or no effect upon the mixture.

Plan of Study and Methods Employed

All of the work thus far described was done with double or triple combinations of spray materials but the possible effect upon the composition of the mixture due to the sequence in which the separate ingredients were added was not considered. The work herein reported began with a study of the effect of different orders of mixing upon the composition of a mixture containing four ingredients, but as the work progressed it seemed advisable to extend its scope to include all possible double and triple combinations as well.

In preparing the experimental mixtures the conditions obtaining in practical spraying operations were followed as closely as possible. Thus, the materials used were market products of standard grades, and the proportions in which they were mixed, and the method of mixing, are fairly representative of field practice. It will be seen that the period of agitation was one hour, which is about the maximum time required to apply a two hundred gallon tank of spray mixture, using one gun or two rods. With many outfits much less time than this would be required so that this agitation period is probably nearer the maximum than the minimum for the average spray rig.

FORMULA

The complete formula used and its equivalent in actual spraying practice are as follows:

	Experimental Mixture	Corresponding Field Practice
(1) Arsenate of lead (acid)	2.4 grams	4.0 pounds
(2) Nicotine sulphate	0.6 cc	0.96 pint
(3) Casein-lime	0.55 grams	0.917 pounds
(4) Lime-sulphur	14.5 cc	2.6 gallons
(5) Water (distilled), to make	500.0 cc	100.0 gallons

PREPARATION OF EXPERIMENTAL MIXTURES

In mixing the ingredients, whatever the number chosen, the final volume was brought to 500 cc and the manipulation was uniformly as follows:

Place about 485 cc of water in a 500 cc graduated shaking flask. Add the ingredients separately, in the amounts indicated by the formula, shaking by hand for two minutes after each addition. Stopper the flask securely, place in a shaking machine of the revolving type and agitate the mixture for one hour. Remove the flask from the shaking device and allow the mixture to stand for one hour. Filter on a 9 cm filter paper using a Buchner funnel with gentle suction, transferring as much of the insoluble material as possible to the filter. Do not rinse the flask or wash the residue upon the filter. Transfer the yellow filtrate (A), to a suitable flask, stopper, and hold for analysis.

Return the filter with the insoluble residue to the original graduated shaking flask and wash into the flask also any of the insoluble residue which may have adhered to the funnel. Fill the flask to the 500 cc mark, stopper securely, place in the shaking machine and agitate the contents for one hour. Remove the flask from the shaking device and allow to stand for one hour, after which filter through a large filter. Do not wash the residue. Reserve the filtrate, solution (B), for analysis.

EXAMINATION OF MIXTURES

The various experimental mixtures were examined with reference to certain physical characteristics and to chemical composition, the latter being confined to determinations of total sulphur in the lime-sulphur solution (filtrate A), and of total arsenic, as arsenic pentoxide (As_2O_5), both in filtrate A and filtrate B. The results obtained for total sulphur are of interest as an index to the extent of chemical change which has taken place in the mixture so far, at least, as the sulphur originally present has been converted into insoluble forms. Foliage injury, in part, results from excessive amounts of soluble arsenic in the lime-sulphur solution; and it seems not improbable that the insoluble arsenic-containing residue which is deposited upon foliage in the process of spraying might become, upon exposure to weather conditions, a potential source of further injury. For this reason the water-soluble arsenic in the insoluble residue was determined.

METHODS OF ANALYSIS

The determination of the small amounts of soluble arsenic involved in preparations made on the scale of these laboratory mixtures presented some difficulty. After some preliminary trials, the method used by Bradley[2] and by others whereby sulphur is oxidized by means of hydrogen peroxide and arsenic finally titrated with dilute iodine solution appeared to be promising. The results, however, were not satisfactory and the method is objec-

tionable chiefly for the following reasons: it requires large quantities of a relatively expensive reagent (hydrogen peroxide); the evaporation of a large volume of liquid is time consuming; the filtration of the large amount of sediment which forms during the evaporation, and the necessary washing, introduce potential errors; and finally, the iodine titration does not give a sharply defined end point.

About this time Cox[5] published a critical review of certain methods for the determination of small quantities of arsenic, citing particularly the methods of Bang and Ramberg, his experience favoring the last named. As pointed out by Cox, neither method involves any new principle, but, on trial, the Ramberg method was found to be adaptable to our problem. Briefly, the procedure consists in oxidizing the sulphur and destroying organic matter by digestion with nitric and sulphuric acids, removing the excess of nitric acid by means of ammonium oxalate, distilling with hydrochloric acid and titrating the arsenic with potassium bromate solution, using methyl orange (1 : 5000) as as indicator.

The digestion was conducted in a long-neck Kjeldahl flask made to fit a condensing tube with a ground glass joint; thus the digestion and distillation were both made without a transfer of material. Arsenic-free reagents, tested by means of suitable blanks, were used throughout. The standard potassium bromate solution was prepared of such strength that 1 cc was equivalent to 0.0005 gm. of arsenic pentoxide (As_2O_5).

The procedure in detail as used by us is as follows:

Arsenic in lime-sulphur solution (*Solution A*). Transfer 100 cc of the solution to the digestion-distillation flask, add a few glass beads, 50 cc of concentrated nitric acid and evaporate over a low flame until the volume is reduced to about 25 cc. Cool, add 25 cc of concentrated sulphuric acid and heat until fumes of sulphuric acid appear. From a suitable dropping device add 50 cc of concentrated nitric acid dropwise, meanwhile boiling the solution very gently. Continue the boiling until sulphuric acid fumes appear. Cool, add 25 cc of saturated ammonium oxalate solution and again boil until fumes of sulphuric acid are noticed. Cool, rinse the neck of the flask with 20 cc of water and then add 2 grams of ferrous sulphate, 50 cc of concentrated hydrochloric acid and 0.1 gram of potassium bromide. (If any yellow or brown color appears at this point nitrogen acids are present and the experiment must be rejected.) Connect the flask with the condensing tube, adjust a receiving flask containing 150 cc of water, and allow the condenser to dip about 1 cm. below the surface of the liquid therein. Distill at such a rate that 20 to 25 cc of distillate are obtained in about 10 minutes. Heat the distillate to 50° C., add three drops of methyl orange and titrate at once with standard potassium bromate solution, adding this reagent very slowly as the end point is approached. The end point is reached when the red color of the indicator is discharged. Each cc of potassium bromate used corresponds to 0.0005 gram of As_2O_5.

Arsenic in Solution B. Transfer 50 cc of the solution to the digestion-distillation flask, add 50 cc of concentrated nitric acid and evaporate over a low flame until the volume is reduced to about 25 cc. Cool, add 25 cc of concentrated sulphuric acid and boil until sulphuric acid fumes appear.

Cool, add 10 cc of concentrated nitric acid and again heat until fumes of sulphuric acid are noted. Cool, add 25 cc of saturated ammonium oxalate solution and from this point proceed as directed in the previous paragraph.

Total sulphur in Solution A. Total sulphur was determined substantially according to the official procedure[1] except that oxidation of sulphur was effected by means of hydrogen peroxide in alkaline solution as allowed by a former optional method.[18]

Transfer 10 cc of solution A to a 250 cc beaker containing 10 cc of a 10 per cent solution of sodium hydroxide, 50 cc of water and 50 cc of hydrogen peroxide. Cover the beaker with a watch glass and heat for one hour on a steam bath. Cool, acidify with dilute hydrochloric acid (1 to 1), and precipitate the sulphur as barium sulphate. Calculate the percentage of sulphur from the weight of barium sulphate, using the factor 0.1374.

PRELIMINARY EXPERIMENTS

The adaptability of the method for the determination of arsenic as described may be illustrated by the following experiments. Blanks on the reagents, in the amounts used in the method, showed titerable substances equivalent to 0.3 cc of standard potassium bromate and this correction was uniformly made in all determinations.

	Arsenic, as As_2O_5			
Material	Present gm.	Added gm.	Total gm.	Recovered gm.
100 cc water+1 gm. sugar		0.01160	0.01160	0.01160
100 cc water+1 gm. sugar		0.01160	0.01160	0.01160
Lime-sulphur-Lead arsenate	0.00613	0.01160	0.01773	0.01775
		0.01160	0.01773	0.01773

INTERPRETATION OF RESULTS

In the analytical data herein reported total sulphur is expressed in terms of grams per 100 cc of the lime-sulphur solution. Arsenic is expressed in percentages of As_2O_5 based on the amount of lead arsenate, 2.4 grams, present in the mixture.

In the tables also abbreviations are necessary and the following are used: L.A. = Lead arsenate; L.S. = Lime-sulphur; N. S. = Nicotine sulphate; C.L. = Casein-Lime; L. = Lime; Blk. = Black; G. = Grey; G.B. = Greyish-black.

TABLE 1. EFFECT OF COMBINING LIME-SULPHUR WITH LEAD ARSENATE

Exp. No.	Order of Mixing 1	2	3	4	Physical Characteristics: Color of finished mixture	Color of sediment	Filtered solution	Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used: In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur In Lime-Sulphur solution gm/100 cc
A-1	L. A.	....	....	....	....	....	....	....	0.05	0.05	....
A-2	L. S.	....	....	....	....	....	....	....	....	....	.923
B-1	L. A.	L. S.	....	....	....	....	....	0.98	5.48	6.46	.907
B-2	L. S.	L. A.	....	....	....	....	....	1.49	5.72	7.21	.890

TABLE 2. EFFECT OF ADDING LIME-SULPHUR TO LEAD ARSENATE AND NICOTINE SULPHATE ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

B-3	L. A.	N. S.	....	....	....	....	....	....	0.06	0.06	....
B-4	N. S.	L. A.	....	....	....	....	....	....	0.03	0.03	....
C-2	L. A.	N. S.	L. S.	....	Light	G. B.	Clear	1.03	4.20	5.23	.890
C-1	L. A.	L. S.	N. S.	....	Light	Blk.	Clear	1.74	0.52	2.26	.604
C-3	L. S.	L. A.	N. S.	....	Light	Blk.	Clear	1.28	0.30	1.58	.611
C-4	L. S.	N. S.	L. A.	....	Light	G. B.	Clear	1.77	4.63	6.40	.820
C-5	N. S.	L. S.	L. A.	....	Light	G. B.	Clear	1.06	4.40	5.46	.884
C-6	N. S.	L. A.	L. S.	....	Light	G. B.	Clear	1.06	3.78	4.84	.873

TABLE 3. EFFECT OF ADDING LIME-SULPHUR TO LEAD ARSENATE, NICOTINE SULPHATE AND CASEIN-LIME ALREADY IN COMBINATION, AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

Exp. No.	Order of Mixing 1	2	3	4	Physical Characteristics: Color of finished mixture	Color of sediment	Filtered solution	Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used: In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur In Lime-Sulphur solution gm/100 cc
C-14	L. A.	N. S.	C. L.	....	....	....	Turbid	0.20	0.48	0.68	....
1	L. A.	N. S.	C. L.	L. S.	Light	G. B.	Clear	0.40	2.55	2.95	.930
12	L. S.	L. A.	N. S.	C. L.	Light	Blk.	Clear	0.90	0.41	1.31	.678
C-13	L. A.	C. L.	N. S.	....	....	....	Turbid	0.30	0.60	0.90	....
2	L. A.	C. L.	N. S.	L. S.	Dark	G. B.	Clear	0.47	2.83	3.30	.925
9	L. S.	L. A.	C. L.	N. S.	Light	G. B.	Turbid	0.47	0.98	1.45	.907
C-15	C. L.	L. A.	N. S.	....	....	....	Turbid	0.31	0.56	0.87	....
8	C. L.	L. A.	N. S.	L. S.	Dark	G. B.	Clear	0.60	2.65	3.25	.916
15	L. S.	C. L.	L. A.	N. S.	Dark	G. B.	Turbid	0.55	1.35	1.90	.912
C-16	N. S.	L. A.	C. L.	....	....	....	Turbid	0.23	0.40	0.63	....
7	N. S.	L. A.	C. L.	L. S.	Light	G. B.	Clear	0.39	2.55	2.94	.919
16	L. S.	N. S.	L. A.	C. L.	Light	Dark	Clear	0.65	2.40	3.05	.838
C-17	N. S.	C. L.	L. A.	....	....	....	Turbid	0.25	0.94	1.19	....
17	N. S.	C. L.	L. A.	L. S.	Light	G. B.	Clear	0.41	2.56	2.97	.906
23	L. S.	N. S.	C. L.	L. A.	Light	G. B.	Turbid	0.39	1.40	1.79	.907
C-18	C. L.	N. S.	L. A.	....	....	....	Clear	0.30	1.20	1.50	....
14	C. L.	N. S.	L. A.	L. S.	Dark	G. B.	Turbid	0.33	2.77	3.10	.920
21	L. S.	C. L.	N. S.	L. A.	Dark	G. B.	Clear	0.48	1.71	2.19	.916

Discussion

Effect of Adding Lime-Sulphur to Different Ingredients Separately and Combined (Tables 1 to 3)

It will be seen that addition of lime-sulphur to lead arsenate brings about a tremendous increase in soluble arsenic,—nearly 136 times the original content of the lead arsenate alone. When lime-sulphur is added to nicotine sulphate and lead arsenate in combination there is likewise a great increase,—34 to 140 times, while in the complete quadruple combination the increase is not so great, due probably to addition of casein-lime in the mixture. It is thus evident that there is an important reaction between lime-sulphur and lead arsenate, but that this is not increased by nicotine sulphate, and is lessened when casein-lime is added.

TABLE 4. EFFECT OF COMBINING NICOTINE SULPHATE WITH LEAD ARSENATE AND LIME-SULPHUR

Exp. No.	Order of Mixing 1	2	3	4	Physical Characteristics: Color of finished mixture	Color of sediment	Filtered solution	Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used: In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur In Lime-Sulphur solution gm/100 cc
A-1	L. A.	....	....	....	....	....	....	....	0.05	0.05	....
B-3	L. A.	N. S.	....	....	....	....	....	....	0.06	0.06	....
B-4	N. S.	L. A.	....	....	....	....	....	....	0.03	0.03	....
A-2	L. S.	....	....	....	....	....	....	....	....	....	.923
B-7	L. S.	N. S.	....	....	....	....	....	....	....	....	.933
B-8	N. S.	L. S.	....	....	....	....	....	....	....	....	.928

TABLE 5. EFFECT OF ADDING NICOTINE SULPHATE TO LIME-SULPHUR AND CASEIN-LIME ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

B-9	L. S.	C. L.	....	....	....	....	....	....	....	....	.916
B-10	C. L.	L. S.	....	....	Light	....	....	....	....	....	.905
C-20	L. S.	C. L.	N. S.	....	....	....	....	....	....	....	.930
C-22	C. L.	L. S.	N. S.	....	....	....	....	....	....	....	.936

TABLE 6. EFFECT OF ADDING NICOTINE SULPHATE TO LEAD ARSENATE AND CASEIN-LIME ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

B-5	L. A.	C. L.	....	....	....	....	....	....	0.28	0.28	....
B-6	C. L.	L. A.	....	....	....	....	....	....	0.28	0 28	....
C-13	L. A.	C. L.	N. S.	....	....	....	....	0.30*	0.60	0.90	....
C-15	C. L.	L. A.	N. S.	....	....	....	....	0.31*	0.56	0.87	....

* Soluble in water.

TABLE 7. EFFECT OF ADDING NICOTINE SULPHATE TO LEAD ARSENATE AND LIME-SULPHUR ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

Exp. No.	Order of Mixing 1	2	3	4	Physical Characteristics: Color of finished mixture	Color of sediment	Filtered solution	Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used: In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur In Lime-Sulphur solution gm/100 cc
B-1	L. A.	L. S.	....	....	Light	G. B.	Clear	0.98	5.48	6.46	.907
B-2	L. S.	L. A.	....	....	Light	G. B.	Clear	1.49	5.72	7.21	.890
C-1	L. A.	L. S.	N. S.	....	Light	Blk.	Clear	1.74	0.52	2.26	.604
C-3	L. S.	L. A.	N. S.	....	Light	Blk.	Clear	1.28	0.30	1.58	.611
C-5	N. S.	L. S.	L. A.	....	Light	G. B.	Clear	1.06	4.40	5.46	.884
C-6	N. S.	L. A.	L. S.	....	Light	G. B.	Clear	1.06	3.78	4.84	.873
C-4	L. S.	N. S.	L. A.	....	Light	G. B.	Clear	1.77	4.63	6.40	.820
C-2	L. A.	N. S.	L. S.	....	Light	G. B.	Clear	1.03	4.20	5.23	.890

TABLE 8. EFFECT OF ADDING NICOTINE SULPHATE TO LEAD ARSENATE, CASEIN-LIME AND LIME-SULPHUR ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

C-7	L. A.	C. L.	L. S.	....	Light	G. B.	Turbid	0.41	2.58	2.99	.915
6	L. A.	C. L.	L. S.	N. S.	Dark	G. B.	Turbid	0.50	2.33	2.83	.916
7	N. S.	L. A.	C. L.	L. S.	Light	G. B.	Clear	0.39	2.55	2.94	.919
C-8	L. A.	L. S.	C. L.	....	Light	G. B.	Turbid	0.35	1.56	1.91	.916
3	L. A.	L. S.	C. L.	N. S.	Light	G. B.	Turbid	0.43	1.19	1.62	.915
10	N. S.	L. A.	L. S.	C. L.	Light	G. B.	Turbid	0.29	1.33	1.62	.912
C-9	C. L.	L. A.	L. S.	....	Dark	L. G.	Clear	0.40	2.56	2.96	.928
11	C. L.	L. A.	L. S.	N. S.	Dark	G. B.	Clear	0.69	2.60	3.29	.918
17	N. S.	C. L.	L. A.	L. S.	Light	G. B.	Clear	0.41	2.56	2.97	.906
C-10	L. S.	L. A.	C. L.	....	Light	G. B.	Turbid	0.40	1.93	2.33	.920
9	L. S.	L. A.	C. L.	N. S.	Light	G. B.	Turbid	0.47	0.98	1.45	.907
13	N. S.	L. S.	L. A.	C. L.	Light	Blk.	Clear	0.55	2.31	2.86	.800
C-11	L. S.	C. L.	L. A.	....	Light	G. B.	Turbid	0.46	1.91	2.37	.920
15	L. S.	C. L.	L. A.	N. S.	Dark	G. B.	Turbid	0.55	1.35	1.90	.912
19	N. S.	L. S.	C. L.	L. A.	Light	G. B.	Turbid	0.40	1.06	1.46	.907
C-12	C. L.	L. S.	L. A.	....	Light	G. B.	Turbid	0.45	2.52	2.97	.922
18	C. L.	L. S.	L. A.	N. S.	Dark	G. B.	Turbid	0.50	2.80	3.30	.922
24	N. S.	C. L.	L. S.	L. A.	Dark	G. B.	Clear	0.48	2.73	3.21	.916

Effect of Adding Nicotine Sulphate to Different Ingredients Separately and Combined

(Tables 4 to 8)

A study of Tables 4 to 8 shows that there is a negligible action when nicotine sulphate and lime-sulphur are mixed together as regards total sulphur in solution. There is likewise little or no action when nicotine sulphate and lead arsenate are mixed together. When nicotine sulphate is added to lime-sulphur and casein-lime in combination, not so much sulphur is precipitated from the solution although the difference is small and of doubtful importance. When added to lead arsenate and casein-lime there is a distinct increase in soluble arsenic and when nicotine sulphate is added to lead arsenate and lime-sulphur in combination there is a decrease in soluble arsenic, and also a decrease in the amount of sulphur in solution. Added to triple combinations as in Table 8, there are variable results. The sulphur content of the filtrate is only slightly altered and the soluble arsenic is decreased in 8 cases but increased in 4.

TABLE 9. EFFECT OF COMBINING CASEIN-LIME WITH LEAD ARSENATE AND LIME-SULPHUR

Exp. No.	Order of Mixing 1	2	3	4	Physical Characteristics: Color of finished mixture	Color of sediment	Filtered solution	Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used: In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur In Lime-Sulphur solution gm/100 cc
A-1	L. A.	....	....	....	....	....	....	....	0.05	0.05	....
B-5	L. A.	C. L.	....	....	....	....	....	....	0.28	0.28	....
B-6	C. L.	L. A.	....	....	....	....	....	....	0.28	0.28	....
A-2	L. S.	....	....	....	....	....	....	....	....	....	.923
B-9	L. S.	C. L.	....	....	....	....	....	....	....	....	.916
B-10	C. L.	L. S.	....	....	Light	....	....	....	....	....	.905

TABLE 10. EFFECT OF ADDING CASEIN-LIME TO LEAD ARSENATE AND LIME-SULPHUR ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

B-1	L. A.	L. S.	....	....	Light	G. B.	Clear	0.98	5.48	6.46	.907
B-2	L. S.	L. A.	....	....	Light	G. B.	Clear	1.49	5.72	7.21	.890
C-8	L. A.	L. S.	C. L.	....	Light	G. B.	Turbid	0.35	1.56	1.91	.916
C-10	L. S.	L. A.	C. L.	....	Light	G. B.	Turbid	0.40	1.93	2.33	.920
C-7	L. A.	C. L.	L. S.	....	Light	G. B.	Turbid	0.41	2.58	2.99	.915
C-9	C. L.	L. A.	L. S.	....	Dark	L. G.	Clear	0.40	2.56	2.96	.928
C-11	L. S.	C. L.	L. A.	....	Light	G. B.	Turbid	0.46	1.91	2.37	.920
C-12	C. L.	L. S.	L. A.	....	Light	G. B.	Turbid	0.45	2.52	2.97	.922

TABLE 11. EFFECT OF ADDING CASEIN-LIME TO LEAD ARSENATE AND NICOTINE SULPHATE ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

B-3	L. A.	N. S.	....	....	....	....	....	....	0.06	0.06	....
B-4	N. S.	L. A.	....	....	....	....	....	...	0.03	0.03	....
C-14	L. A.	N. S.	C. L.	....	....	....	Turbid	0.20	0.48	0.68	....
C-16	N. S.	L. A.	C. L.	....	Clear	....	Turbid	0.23	0.40	0.63	....
C-13	L. A.	C. L.	N. S.	....	Clear	....	Turbid	0.30	0.60	0.90	....
C-15	C. L.	L. A.	N. S.	....	Clear	....	Turbid	0.31	0.56	0.87	....
C-17	N. S.	C. L.	L. A.	....	Clear	....	Turbid	0 25	0.94	1.19	....
C-18	C. L.	N. S.	L. A.	....	Clear	....	Clear	0.30	1.20	1.50	....

TABLE 12. EFFECT OF ADDING CASEIN-LIME TO LIME-SULPHUR AND NICOTINE SULPHATE IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

Exp. No.	Order of Mixing 1	2	3	4	Physical Characteristics: Color of finished mixture	Color of sediment	Filtered solution	Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used: In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur In Lime-Sulphur solution gm/100 cc
B-7	L. S.	N. S.	....	....	....	....	....	....	....	....	.933
B-8	N. S.	L. S.	....	....	....	....	....	....	....	....	.928
C-19	L. S.	N. S.	C. L.	....	Dark	....	....	....	....	....	.925
C-21	N. S.	L. S.	C. L.	....	Dark	....	....	....	....	....	.930
C-20	L. S.	C. L.	N. S.	....	....	....	....	....	....	....	.930
C-22	C. L.	L. S.	N. S.	....	....	....	....	....	....	....	.936
C-23	N. S.	C. L.	L. S.	....	....	....	....	....	....	....	.934
C-24	C. L.	N. S.	L. S.	....	....	....	....	....	....	....	.935

TABLE 13. EFFECT OF ADDING CASEIN-LIME TO LEAD ARSENATE, NICOTINE SULPHATE AND LIME-SULPHUR IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

C-1	L. A.	L. S.	N. S.	....	Light	Blk.	Clear	1.74	0.52	2.26	.604
4	L. A.	L. S.	N. S.	C. L.	Light	Blk.	Turbid	0.71	1.62	2.33	.827
11	C. L.	L. A.	L. S.	N. S.	Dark	G. B.	Clear	0.69	2.60	3.29	.918
C-2	L. A.	N. S.	L. S.	....	Light	G. B.	Clear	1.03	4.20	5.23	.890
5	L. A.	N. S.	L. S.	C. L.	Light	Blk.	Clear	0.81	0.29	1.10	.716
8	C. L.	L. A.	N. S.	L. S.	Dark	G. B.	Clear	0.60	2.65	3.25	.916
C-3	L. S.	L. A.	N. S.	....	Light	Blk.	Clear	1.28	0.30	1.58	.611
12	L. S.	L. A.	N. S.	C. L.	Light	Blk.	Clear	0.90	0.41	1.31	.678
18	C. L.	L. S.	L. A.	N. S.	Dark	G. B.	Turbid	0.50	2.80	3.30	.922
C-4	L. S.	N. S.	L. A.	....	Light	G. B.	Clear	1.77	4.63	6.40	.820
16	L. S.	N. S.	L. A.	C. L.	Light	Dark	Clear	0.65	2.40	3.05	.838
20	C. L.	L. S.	N. S.	L. A.	Dark	G. B.	Clear	0.50	2.69	3.19	.906
C-5	N. S.	L. S.	L. A.	....	Light	G. B.	Clear	1.06	4.40	5.46	.884
13	N. S.	L. S.	L. A.	C. L.	Light	Blk.	Clear	0.55	2.31	2.86	.800
22	C. L.	N. S.	L. S.	L. A.	Dark	G. B.	Clear	0.41	2.54	2.95	.913
C-6	N. S.	L. A.	L. S.	....	Light	G. B.	Clear	1.06	3.78	4.84	.873
10	N. S.	L. A.	L. S.	C. L.	Light	G. B.	Turbid	0.29	1.33	1.62	.912
14	C. L.	N. S.	L. A.	L. S.	Dark	G. B.	Turbid	0.33	2.77	3.10	.920

Effect of Adding Casein-Lime to Different Ingredients Separately and Combined

(Tables 9 to 13)

It will be seen from Table 9 that the addition of casein-lime increased the soluble arsenic and reduced the sulphur when mixed with lead arsenate and lime-sulphur alone. When added to lead arsenate and lime-sulphur in combination, the amount of soluble arsenic is greatly reduced and the sulphur in solution is increased.

When added to nicotine sulphate and lead arsenate in combination the soluble arsenic is distinctly increased, but when added to lime-sulphur and nicotine sulphate the sulphur content of the solution is not greatly altered. In quadruple mixtures, Table 13, there seems to be, in general, an increase of sulphur in solution where casein-lime is used over mixtures where this material is omitted; and, in general, the soluble arsenic is reduced, but it may sometimes be increased.

Effect of Replacing Casein-Lime with Pure Lime (Table 14)

In order to find out whether the casein or lime of the casein-lime mixture was responsible for the results noted in Tables 9 to 13, a quantity of pure lime (CaO), equivalent to the amount used in the casein-lime, was substituted (D1). This amount was then doubled (D2). It will be seen that the amount of soluble arsenic is decreased as much or more by lime alone as by casein-lime (Exp. No. 2); also that the amount of sulphur in solution is not greatly reduced by the additional lime.

Effect of Different Orders of Mixing on Quadruple Mixtures (Table 15)

It is easily demonstrated that different orders of mixing produce differently colored mixtures, but to determine if possible the value of this criterion for judging spray mixtures Table 15 was prepared. It will be seen that some of the mixtures are dark in color while others are light. It was noted in the course of the work that some of the blackness of the resulting spray was due to the mixture of lime-sulphur and nicotine sulphate as well as the formation of lead sulphide as noted by others. The actual color of the sediment does not vary greatly, but there is a considerable variation in the turbidity of the filtrate, certain ones remaining clear, while others produce a decided murkiness. The turbid filtrates were tested by chemical means and found to be due to a very finely divided sulphur and not to lead, calcium or

TABLE 14. EFFECT OF REPLACING CASEIN-LIME WITH PURE LIME, EQUAL IN AMOUNT AND DOUBLE THE ORIGINAL CONTENT OF THE CASEIN-LIME

Exp. No.	Order of Mixing 1	2	3	4	Physical Characteristics: Color of finished mixture	Color of sediment	Filtered solution	Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used: In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur In Lime-Sulphur solution gm/100 cc
C-2	L. A.	N. S.	L. S.	....	Light	G. B.	Clear	1.03	4.20	5.24	.890
D-1	L. A.	L.*	N. S.	L. S.	Light	G.	Clear	0.31	1.21	1.52	.921
D-2	L. A.	L.**	N. S.	L. S.	Light	G.	Clear	0.25	0.27	0.52	.915
2	L. A.	C. L.	N. S.	L. S.	Dark	G. B.	Clear	0.47	2.83	3.30	.925

*0.3 gm.
**0.6 gm.

TABLE 15. EFFECT OF DIFFERENT ORDERS OF MIXING ON QUADRUPLE MIXTURES

1	L. A.	N. S.	C. L.	L. S.	Light	G. B.	Clear	0.40	2.55	2.95	.930
2	L. A.	C. L.	N. S.	L. S.	Dark	G. B.	Clear	0.47	2.83	3.30	.925
3	L. A.	L. S.	C. L.	N. S.	Light	G. B.	Turbid	0.43	1.19	1.62	.915
4	L. A.	L. S.	N. S.	C. L.	Light	Blk.	Turbid	0.71	1.62	2.33	.827
5	L. A.	N. S.	L. S.	C. L.	Light	Blk.	Clear	0.81	0.29	1.10	.716
6	L. A.	C. L.	L. S.	N. S.	Dark	G. B.	Turbid	0.50	2.33	2.83	.916
7	N. S.	L. A.	C. L.	L. S.	Light	G. B.	Clear	0.39	2.55	2.94	.919
8	C. L.	L. A.	N. S.	L. S.	Dark	G. B.	Clear	0.60	2.65	3.25	.916
9	L. S.	L. A.	C. L.	N. S.	Light	G. B.	Turbid	0.47	0.98	1.45	.907
10	N. S.	L. A.	L. S.	C. L.	Light	G. B.	Turbid	0.29	1.33	1.62	.912
11	C. L.	L. A.	L. S.	N. S.	Dark	G. B.	Clear	0.69	2.60	3.29	.918
12	L. S.	L. A.	N. S.	C. L.	Light	Blk.	Clear	0.90	0.41	1.31	.678
13	N. S.	L. S.	L. A.	C. L.	Light	Blk.	Clear	0.55	2.31	2.86	.800
14	C. L.	N. S.	L. A.	L. S.	Dark	G. B.	Turbid	0.33	2.77	3.10	.920
15	L. S.	C. L.	L. A.	N. S.	Dark	G. B.	Turbid	0.55	1.35	1.90	.912
16	L. S.	N. S.	L. A.	C. L.	Light	Blk.	Clear	0.65	2.40	3.05	.838
17	N. S.	C. L.	L. A.	L. S.	Light	G. B.	Clear	0.41	2.56	2.97	.906
18	C. L.	L. S.	L. A.	N. S.	Dark	G. B.	Turbid	0.50	2.80	3.30	.922
19	N. S.	L. S.	C. L.	L. A.	Light	G. B.	Turbid	0.40	1.06	1.46	.907
20	C. L.	L. S.	N. S.	L. A.	Dark	G. B.	Clear	0.50	2.69	3.19	.906
21	L. S.	C. L.	N. S.	L. A.	Dark	G. B.	Clear	0.48	1.71	2.19	.916
22	C. L.	N. S.	L. S.	L. A.	Dark	G. B.	Clear	0.41	2.54	2.95	.913
23	L. S.	N. S.	C. L.	L. A.	Light	G. B.	Turbid	0.39	1.40	1.79	.907
24	N. S.	C. L.	L. S.	L. A.	Dark	G. B.	Clear	0.48	2.73	3.21	.916

nicotine. This fact is of some significance in spraying practices since it has been demonstrated that colloidal sulphurs are important fungicides.[28] Whether such combinations as these, however, contain enough colloidal sulphur to affect the efficiency of the spray has not been determined.

It will be noted that combinations showing the lowest arsenic in solution (Nos. 5 and 12) are both extremely low in soluble sulphur and that both filtrates are clear. It would probably not be wise to select merely on the basis of soluble arsenic and sulphur content alone, although we know from the work of Saffro[19] that spray injury may be caused by calcium polysulphides and to a less extent by calcium thiosulphate (p. 32). An attempt to avoid spray injury would, therefore, include selection of mixtures low in sulphur and arsenic in solution, but these would probably be reduced in fungicidal action since the filtrates are clear and the total sulphur, supposedly the active forms, is reduced 25% or more (Nos. 5 and 12). It is important to note that in all cases the greater part of the soluble arsenic is found in the residue which emphasizes the necessity of cleaning the spray tank frequently, in order to avoid accumulation of sludge from previous tanks, and the importance of ample agitation to avoid this difficulty.

General Conclusions

(1) The Bramberg method of determining small amounts of arsenic has been found adaptable to the determination of soluble arsenic in spray mixtures.

(2) *Lime-sulphur* reacts strongly with lead arsenate* giving increased soluble arsenic and decreased sulphur in solution. It reacts similarly with lead arsenate and nicotine sulphate in combination and with lead arsenate and casein-lime but the reaction is not as great in the latter case.

(3) *Nicotine sulphate* does not react with lead arsenate or with lime-sulphur so far as indicated by the chemical data; a color change is noted, the significance of which is not explained. When added to lead arsenate and casein-lime together the soluble arsenic is increased; added to lead arsenate and lime-sulphur together there is a marked decrease in soluble arsenic and also a decrease in the amount of sulphur in solution. When added to triple combinations of lead arsenate, casein-lime and lime-sulphur, variable results are noted.

(4) *Casein-lime* increases the soluble arsenic content of lead arsenate when mixed with it alone. When mixed with

* Acid lead arsenate is implied wherever lead arsenate is mentioned.

lime-sulphur alone the amount of sulphur in solution is somewhat reduced. When added to nicotine sulphate and lead arsenate the soluble arsenic is distinctly increased, but when added to lime-sulphur and nicotine sulphate the sulphur content of the solution is not greatly altered. In quadruple mixtures there is, in general, an increase of sulphur in solution due to the casein-lime and there is in general a decrease in soluble arsenic. The latter, however, may sometimes be increased.

(5) The lime in casein-lime is largely responsible for the decrease in soluble arsenic where this material is used.

(6) Different orders of mixing quadruple mixtures give different results, but so many factors are involved and the variations are so small that the selection of improved mixtures seems an impossibility.

(7) Colloidal sulphur is sometimes formed in the spray mixtures.

(8) The color of the resulting mixture is not a satisfactory means of judging a spray solution.

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